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SELECTED WATER RESOURCES ABSTRACTS

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SELECTED WATER RESOURCES ABSTRACTS

A monthly publication of the Geological Survey
U.S. Department of the Interior

VOLUME 22, NUMBER 11
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The Secretary of the Interior has determined that the publication of this periodical is necessary in the transaction of the public business required by law of this Department. Use of funds for printing this periodical has been approved by the Office of Management and Budget through September 1990.

As the Nation's principal conservation agency, the Department of the Interior has responsibility for most of our nationally owned public lands and natural resources. This includes fostering the wisest use of our land and water resources, protecting our fish and wildlife, preserving the environmental and cultural values of our national parks and historical places, and providing for the enjoyment of life through outdoor recreation. The Department assesses our energy and mineral resources and works to assure that their development is in the best interests of all our people. The Department also has a major responsibility for American Indian reservation communities and for people who live in Island Territories under U.S. administration.

PREFACE

Selected Water Resources Abstracts, a monthly journal, includes abstracts of current and earlier pertinent monographs, journal articles, reports, and other publication formats. These documents cover water resources as treated in the life, physical, and social sciences and the related engineering and legal aspects of the characteristics, supply condition, conservation, control, use, or management of water resources. Each abstract includes a full bibliographic citation and a set of descriptors which are listed in the **Water Resources Thesaurus.** The abstract entries are classified into 10 fields and 60 groups similar to the water resources research categories established by the Committee on Water Resources Research of the then Federal Council for Science and Technology.

Selected Water Resources Abstracts is designed to serve the scientific and technical information needs of scientists, engineers, and managers as one of several services of the Water Resources Scientific Information Center. The cumulative SWRA file from 1968 and monthly updates are available also in magnetic tape through lease from NTIS.

THE WATER RESOURCES SCIENTIFIC INFORMATION CENTER DOES NOT PROVIDE COPIES OF DOCUMENTS ABSTRACTED IN THIS JOURNAL. Sufficient bibliographic information is given to enable readers to order the desired documents from local libraries or other sources.

Comments and suggestions concerning the contents and arrangement of this bulletin are welcome.

Water Resources Scientific
Information Center
U.S. Geological Survey
MS 425 National Center
Reston, VA 22092

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Includes the following Groups: Saline Water Conversion; Water Yield Improvement; Use of Water of Impaired Quality; Conservation in Domestic and Municipal Use; Conservation in Industry; Conservation in Agriculture.

04 WATER QUANTITY MANAGEMENT AND CONTROL

Includes the following Groups: Control of Water on the Surface; Groundwater Management; Effects on Water of Man's Nonwater Activities; Watershed Protection.

05 WATER QUALITY MANAGEMENT AND PROTECTION

Includes the following Groups: Identification of Pollutants; Sources of Pollution; Effects of Pollution; Waste Treatment Processes; Ultimate Disposal of Wastes; Water Treatment and Quality Alteration; Water Quality Control.

06 WATER RESOURCES PLANNING

Includes the following Groups: Techniques of Planning; Evaluation Process; Cost Allocation, Cost Sharing, Pricing/Repayment; Water Demand; Water Law and Institutions; Nonstructural Alternatives; Ecologic Impact of Water Development.

07 RESOURCES DATA

Includes the following Groups: Network Design; Data Acquisition; Evaluation, Processing and Publication.

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SELECTED WATER RESOURCES ABSTRACTS

1. NATURE OF WATER

1A. Properties

DETERMINATION OF SEAWATER ENTHALPY AND ENTROPY DURING THE CALCULATION OF THERMAL DESALINATION PLANTS.
Dal'nevostochnyi Politekhnicheskii Inst., Vladivostok (USSR).
V. Slesarenko, and A. Shtim.
Desalination DSLNAH, Vol. 71, No. 2, p 203-210, February 1989. 4 fig, 2 tab, 5 ref.

Descriptors: *Limnology, *Water treatment facilities, *Seawater, *Physical properties, *Desalination, *Entropy, *Enthalpy, Thermodynamics, Evaporation, Temperature, Salinity.

In calculating and analyzing the thermodynamics of thermal desalination schemes, it is necessary to have data on enthalpy and entropy of seawater and of the solutions obtained after evaporation. To determine the enthalpy and entropy of seawater on the basis of actual observations, the method of characteristic functions, based on thermodynamic differential equations, was used. Seawater is a multicomponent solution of electrolytes and the divergence of its properties from those of pure water increases with increasing salt concentrations. If we assume that salt composition during evaporation remains unchanged while the concentrations rise, then we can simulate seawater as a binary solution in which pure water is a solvent and 'sea salt' represents a solute. Enthalpy and entropy of solutions can be represented by an algebraic sum of pure water parameters at given temperature and by enthalpy or entropy increments at the corresponding temperature and predetermined concentration of the solution. To confirm the validity of this statement, enthalpy and entropy values of seawater were calculated by using the isobaric heat capacity values. It was established that entropy and enthalpy values coincide at a temperature of 363 K and a salinity of 9.0% but diverge by 12% at a temperature of 399 K and a salinity of 12.0%. The proposed method should be considered more universal since it is not confined by the limits of equations applied. (Sand-PTT)
W89-11205

2. WATER CYCLE

2A. General

STORM RUNOFF CHARACTERISTICS OF GRAZED WATERSHEDS IN EASTERN OREGON.
Chequamegon National Forest, Park Falls, WI.
For primary bibliographic entry see Field 2E.
W89-11164

WATER BALANCE APPROACH UNDER EXTREME ARID CONDITIONS--A CASE STUDY OF TABALAH BASIN, SAUDI ARABIA.
King Abdulaziz Univ., Jeddah (Saudi Arabia). Dept. of Hydrology.
M. J. Abdulrazzak, A. U. Sorman, and A. S. Alhames.
Hydrological Processes HYPRE3, Vol. 3, No. 2, p 107-122, April/June 1989. 7 fig, 6 tab, 32 ref.

Descriptors: *Arid lands, *Arid-zone hydrology, *Arid zone, *Hydrologic cycle, *Precipitation, *Saudi Arabia, *Hydrologic data collections, Storm runoff, Groundwater recharge, Catchment areas, Water policy, Water management, Case studies.

Quantification of water balance components, under arid conditions, is essential to the development of water management policies. The application of the mass water balance approach for the assessment of water resources in a typical watershed located in the southwestern region of Saudi Arabia is demonstrated. The water balance approach was used, on an event basis, to express the amount of precipitation for 13 storms over a three-year period, as a percentage of other hydrological components such as runoff, evaporation, and recharge. The study indicated that 63 percent of precipitation is lost through evaporation from the water surface during flooding, and from the upper layers of the soil surface immediately after storms. Another 32 percent is stored in the form of soil moisture in the unsaturated layers below the effective evaporation depth. Only 3 percent of the precipitation was transformed into surface runoff; however, 75 percent of this contributes toward groundwater recharge. It is shown that a mass water balance approach can b used, with reasonable accuracy, to quantify the components of the hydrological processes under arid conditions, where a reliable data base is available. This, in turn, will help in the development of appropriate water management policies for arid regions. (Author's abstract)
W89-11283

HYDROLOGY OF A SMALL WET CATCHMENT.
Warrnambool Inst. of Advanced Education (Australia). Faculty of Applied Science and Technology.
F. Stagnitti, J. Y. Parlange, and C. W. Rose.
Hydrological Processes HYPRE3, Vol. 3, No. 2, p 137-150, April/June 1989. 5 fig, 3 tab, 31 ref.

Descriptors: *Forest hydrology, *Hydrological regime, *Catchment areas, *Wetland forests, *Wetlands, *Hydrologic budget, *Swamps, *Evapotranspiration, Watersheds, Precipitation, Soil water, Hydrologic models, Hydrologic cycle, Air-earth interfaces.

The hydrology of a small wet forested region is studied. Catchment discharge, solar radiation, air temperature, humidity, precipitation, soil moisture, and the water elevation in a swamp were monitored for several months in 1973 and 1975. These data were used to investigate various aspects of the catchment's hydrology and, in particular, to study the catchment's evapotranspirational requirements. The actual evapotranspiration loss is calculated from a water budget approach. The Priestley-Taylor model is used to predict the medium to long-term evapotranspiration from the basin. The predictions based on the model were in very good agreement with the actual evapotranspirational demand. For example, the model showed that a very high proportion of the evapotranspirational loss can be accounted for primarily by solar radiation. This finding was consistent with earlier documented observations. The Priestley-Taylor equation, with it strong emphasis on net radiation, performs well, as it did in this investigation, because (1) advection plays only a minor role in the overall evapotranspirational demand since the catchment is surrounded by forested hills; (2) a significant portion of the catchment, about 14 percent, is submerged by free water evaporating at the potential rate; and (3) soil moisture studies indicated that even in the upland slopes, the catchment is always wet, permitting vegetation to transpire freely. This study confirms that the Priestly-Taylor equation is a suitable estimator of medium to long-term evapotranspiration loss. (Friedmann-PTT)
W89-11285

TERRAIN-BASED WATERSHED INFORMATION SYSTEM,
Toronto Univ. (Ontario). Dept. of Geography.
For primary bibliographic entry see Field 10D.
W89-11286

HYDROGEOCHEMICAL CONTROLS FOR INORGANIC ALUMINUM IN ACIDIC STREAM AND SOIL WATERS AT TWO UPLAND CATCHMENTS IN WALES.
Institute of Hydrology, Wallingford (England).
C. Neal, B. Reynolds, P. Stevens, and M. Hornung.
Journal of Hydrology JHYDA7, Vol. 106, No. 1/2, p 155-175, March 30, 1989. 9 fig, 4 tab, 42 ref.

Descriptors: *Geohydrology, *Geochemistry, *Soil water, *Wales, *Acid rain effects, *Acidic water, *Aluminum, Acidic soils, Streams, Catchment areas, Soil horizons.

Results of two studies of acidic and acid sensitive catchments typical of upland Wales are presented. The streams draining these catchments are less acidic and contain lower inorganic aluminum concentrations than their soil counterparts. Within each soil horizon, there are distinct linear or curvilinear relationships with H(+) and inorganic aluminum reactions. The stream water H(+) and inorganic aluminum chemistries are determined by mixing of these soil waters with a groundwater component not sampled during these studies except in a partially CO2 degassed form in the stream at extreme baseflow conditions. While during the mixing processes within the soil/groundwater zones, inorganic aluminum may be regulated by simple solubility controls, no such controls are operative within the streams. The classical cubic relationship between the activities of Al(+++) and H(+) for the ion exchange reactions does not hold; a power term, which can vary from site to site and horizon to horizon in the range 1-3, is required. (Author's abstract)
W89-11380

ANALYSIS OF SOIL WATER MOVEMENT ON A SANDY HILLSLOPE.
New Mexico Inst. of Mining and Technology, Socorro. Dept. of Geoscience.
For primary bibliographic entry see Field 2G.
W89-11488

INTERANNUAL FLUCTUATIONS IN PRIMARY PRODUCTION: METEOROLOGICAL FORCING AT TWO SUBALPINE LAKES.
California Univ., Davis. Div. of Environmental Studies.
For primary bibliographic entry see Field 2H.
W89-11516

WRITTEN IN THE WINDS: THE GREAT DROUGHT OF '88.
For primary bibliographic entry see Field 2B.
W89-11538

RAINFALL VARIATION AND SOME IMPLICATIONS FOR FLOODING IN THE ALLAN CATCHMENT, CENTRAL SCOTLAND.
Southern Water Authority, Worthing (England). East Sussex Water and Drainage Div.
For primary bibliographic entry see Field 2B.
W89-11566

EFFECT OF SNOWMELT ON THE HYDROGEN ISOTOPE RATIOS OF CREEK DISCHARGE IN SURPRISE VALLEY, CALIFORNIA,
California Univ., Davis. Dept. of Geology.
For primary bibliographic entry see Field 2C.
W89-11677

ISOTOPE STUDY OF WATER BODIES ALONG A TRAVERSE OF SOUTHWESTERN CANADA,
Calgary Univ. (Alberta). Dept. of Physics.
C. J. Yonge, L. Goldenberg, and H. R. Krouse.
Journal of Hydrology JHYDA7, Vol. 106, No. 3/4, p 245-255, April 20 1989. 4 fig, 2 tab, 24 ref.

Descriptors: *Tracers, *Isotope studies, *Water analysis, *Hydrologic cycle, *Canada, *Environmental tracers, Natural waters, Precipitation, Evaporation, Great Divide.

The O18 and D content of natural waters from southwestern Canada have been used in helping to characterize the regional hydrologic cycle. The isotope data correlate with four major physiographic systems; each one being readily identified by the gradient of delta-value with distance from the coast. In general, mountainous regions to the west exhibit negative gradients, whereas east of the Great Divide, the slope is positive. Comparison of precipitation data from the Olympic Mountains and Vancouver island with that of the Fraser Valley, indicate that vapor is modified by marine evaporation prior to passing over Vancouver. However, the isotopic composition of precipitation

falling between Vancouver and the Great Divide can be interpreted tentatively in terms of a single-stage Rayleigh distillation process. Data east of the Great Divide that do not fall on the Rayleigh curve suggest either evapotranspiration effects or mixing of weather systems derived from other sources. (Author's abstract)
W89-11678

PARAMETER ESTIMATION FOR THE GENERAL EXTREME VALUE DISTRIBUTION.
Asian Inst. of Tech., Bangkok (Thailand).
For primary bibliographic entry see Field 7C.
W89-11742

PHYSICALLY BASED MODEL OF HETEROGENEOUS HILLSLOPES: 1. RUNOFF PRODUCTION,
Lancaster Univ. (England). Centre for Research on Environmental Systems.
A. Binley, J. Elgy, and K. Beven.
Water Resources Research WRERAO, Vol. 25, No. 6, p 1219-1226, June 1989. 8 fig, 1 tab, 5 ref.

Descriptors: *Rainfall-runoff relationships, *Runoff, *Slopes, *Saturated flow, *Model studies, Hydraulic conductivity, Soil water, Simulation, Spatial variation, Scale effects.

A fully three-dimensional model of variably saturated flow on a hillslope has been used to explore the effects of different random patterns of saturated hydraulic conductivity on a 150-m by 100-m hillslope. Both surface and subsurface runoff production were simulated. The model's simulations suggest that peak discharges and runoff volumes generally are increased by the presence of heterogeneity, increasing with increasing variance and spatial dependence of the underlying random field. Simulations using different realizations with the same random field parameters show that, for the case of soils showing no dependence, differences in runoff production between realizations are small at this scale of hillslope. The differences increase with increasing spatial dependence, particularly for the case of low-conductivity soils producing surface runoff. (See also W89-11764) (Author's abstract)
W89-11763

PHYSICALLY BASED MODEL OF HETEROGENEOUS HILLSLOPES: 2. EFFECTIVE HYDRAULIC CONDUCTIVITIES,
Lancaster Univ. (England). Centre for Research on Environmental Systems.
A. Binley, K. Beven, and J. Elgy.
Water Resources Research WRERAO, Vol. 25, No. 6, p 1227-1233, June 1989. 10 fig, 3 tab, 18 ref.

Descriptors: *Rainfall-runoff relationships, *Runoff, *Slopes, *Saturated flow, *Model studies, *Hydraulic conductivity, Equivalent homogeneous hillslopes, Permeability, Soil water, Simulation, Scale effects, Hydrographs.

Using the results of a fully three-dimensional model of variably saturated flow on a heterogeneous hillslope, the concept of equivalent homogeneous hillslopes is explored. By considering single realizations of random patterns of saturated hydraulic conductivity, attempts are made to determine single effective hydraulic conductivity values capable of reproducing both subsurface and surface flow hydrographs. For the case of high-permeability soils, effective parameters were found to reasonably reproduce the hillslope hydrograph, although there was no consistent relationship between the effective values and the moments of the spatial distributions. For the case of low-permeability soils, characterized by surface flow domination of the runoff hydrograph, single effective parameters were not found to be capable of reproducing both subsurface and surface flow responses. Furthermore, the event dependency of effective conductivity values under such conditions was demonstrated. (See also W89-11763) (Author's abstract)
W89-11764

TREE RING ANALYSIS OF SURPLUS AND DEFICIT RUNOFF IN THE WHITE RIVER, ARKANSAS.
Arkansas Univ., Fayetteville. Dept. of Geography.
For primary bibliographic entry see Field 2E.
W89-11778

WATER BALANCE AT A LOW-LEVEL RADIOACTIVE-WASTE DISPOSAL SITE.
Geological Survey, Denver, CO. Water Resources Div.
R. W. Healy, J. R. Gray, M. P. de Vries, and P. C. Mills.
Water Resources Bulletin WARBAQ, Vol. 25, No. 2, p 381-390, April 1989. 10 fig, 1 tab, 17 ref.

Descriptors: *Hydrologic budget, *Precipitation, *Evapotranspiration, *Waste disposal, *Radioactive wastes, Runoff, Disposal sites, Water storage, Mathematical studies.

The water balance at a low-level radioactive waste disposal site in northwestern Illinois was studied from July 1982 through June 1984. Continuous data collection allowed estimates to be made for each component of the water balance equation independent of other components. The average annual precipitation was 948 mm. Average annual evapotranspiration was estimated at 637 mm, runoff was 160 mm, change in water storage in a waste-trench cover was 24 mm, and deep percolation was 208 mm. The magnitude of the difference between precipitation and all other components (81 mm/yr) indicates that, in a similar environment, the water budget method would be useful in estimating evapotranspiration, but questionable for estimation of other components. Precipitation depth and temporal distribution had a very strong effect on all other components of the water-balance equation. Due to the variability of precipitation from year to year, it appears that two years of data are inadequate for characterization of the long-term average water balance at the site. (Author's abstract)
W89-11801

GROUND WATER IN AN UPLAND VALLEY, THE LINGERING INFLUENCE OF A GLACIAL LAKE: WILLIAMSTOWN, MASSACHUSETTS.
Washington Univ., Seattle. Dept. of Geological Sciences.
For primary bibliographic entry see Field 2F.
W89-11945

ANALYSIS OF WATER RESOURCE SYSTEMS.
Ceske Vysoke Uceni Technicke v Praze. Faculty of Civil Engineering and Architecture.
For primary bibliographic entry see Field 6A.
W89-12115

NATIONAL RESEARCH PROGRAM OF THE WATER RESOURCES DIVISION, U.S. GEOLOGICAL SURVEY, FISCAL YEAR 1987.
For primary bibliographic entry see Field 9C.
W89-12134

2B. Precipitation

PRECIPITATION CATCH MEASURED BY THE WYOMING SHIELD AND THE DUAL-GAGE SYSTEM.
Agricultural Research Service, Boise, ID. Northwest Watershed Research Center.
For primary bibliographic entry see Field 7B.
W89-11172

REGIONALIZATION OF STORM HYETOGRAPHS.
Agricultural Research Service, Coshocton, OH. North Appalachian Experimental Watershed.
J. V. Bonta, and A. R. Rao.
Water Resources Bulletin WARBAQ, Vol. 25, No. 1, p 211-217, February 1989. 3 fig, 2 tab, 13 ref.

Descriptors: *Design storms, *Hyetographs, *Rainfall, *Precipitation data, Huff curves, Regional analysis, Chicago, Texas, Illinois, Ohio.

Regionalization of design storms can enhance their utility. Otherwise they have to be separately developed for different regions. Huff curves developed from point rainfall data collected at Coshocton, Ohio and Chicago, Illinois, and from area-averaged Illinois and Texas precipitation data, are compared. The curves are similar in shape and position, with some visual differences depending on quartile. Kolmogorov-Smirnov tests showed no significant differences in most of the comparisons. Where significant differences existed, they may not represent real differences due to the small number of storms sampled. Consequently, regionalization of Huff curves from Ohio to Illinois to Texas may be appropriate. The comparison of Huff curves is affected to an unknown degree both by the effects of area averaging of data and by basis-of-development differences. The effects of observed differences in Huff curves on watershed response variables (e.g., peak flow) requires further study. (Author's abstract)
W89-11178

PROBABILISTIC STORM TRANSPOSITION APPROACH FOR ESTIMATING EXCEEDANCE PROBABALITIES OF EXTREME PRECIPITATION DEPTHS,
Iowa State Univ., Ames. Dept. of Civil Engineering.
E. Foufoula-Georgiou.
Water Resources Research WRERAO, Vol. 25, No. 5, p 799-815, May 1989. 19 fig, 3 tab, 48 ref. NSF Grant CES-8708825.

Descriptors: *Depth-area-duration analysis, *Probabilistic process, *Precipitation intensity, *Storm water, *Rainfall intensity, *Rainstorms, *Precipitation, Rainfall, Rainfall distribution, Catchment areas, Flood peak, Flood frequency, Estimating, Frequency analysis.

A storm transposition approach is investigated as a possible tool of assessing the frequency of extreme precipitation depths, i.e., depths of return period much greater than 100 years. The annual exceedance probability of extreme average precipitation depths over a catchment is estimated. The probabilistic storm transposition methodology is presented. Difficulties arising in the approach include the accuracy in estimation of the storm peak, which is often used for frequency analysis and classification of storms. Also, since the criteria used by the U.S. Army Corps of Engineers for including a storm in the data catalog are not well defined and may have changed over the years, the set of available storms may not always be a representative sample of the true storm set. The method is implemented and is partially evaluated by means of a semihypothetical example involving extreme midwestern storms and two hypothetical catchments (of 100 and 1000 sq mi, or about 260 and 2600 sq km) located in central Iowa and 18 extreme midwestern storms. The tail of the unconditional annual exceedance probability of the average catchment depth was found to follow a smooth and well-behaved curve, supporting the idea of researching methodologies to extrapolate it to lower probabilities. The analysis presented shows that the storm transposition approach may yield more conservative 100-yr return period events, as compared to those obtained by the regional depth-duration-frequency curves. (Friedmann-PTT)
W89-11251

DETECTABILITY OF ACID PRODUCING REACTIONS IN NATURAL CLOUDS.
Brookhaven National Lab., Upton, NY. Environmental Chemistry Div.
For primary bibliographic entry see Field 5A.
W89-11451

ESTIMATES OF REGIONAL CONTRIBUTIONS TO WET ACID DEPOSITION IN WESTERN MASSACHUSETTS DURING THE SUMMER OF 1984.

General Motors Research Labs., Warren, MI. Environmental Science Dept.
For primary bibliographic entry see Field 5B.
W89-11453

IMPORTANCE OF AGRICULTURAL WEATHER INFORMATION: A MICHIGAN SURVEY.
Michigan State Univ., East Lansing. Dept. of Entomology.
For primary bibliographic entry see Field 7A.
W89-11454

TEMPORAL AND SPATIAL VARIATION IN THE VOLUME OF RAIN FALLING ANNUALLY IN ISRAEL.
Agricultural Research Organization, Bet-Dagan (Israel). Inst. of Soils and Water.
G. Stanhill, and C. Rapaport.
Israel Journal of Earth Sciences IJERAK, Vol. 37, No. 4, p 211-221, 1988. 5 fig, 2 tab, 22 ref, append.

Descriptors: *Weather patterns, *Israel, *Rainfall, *Precipitation, *Net rainfall, *Rainfall distribution, Spatial distribution, Temporal distribution, Hydrologic data collection, Meteorological data collections, Annual distribution, Correlation analysis.

The volume of rain falling in Israel annually during the 54 years 1931-1984 and its variation in time and space were estimated from annual rainfall maps. The total annual volume averaged 7.92 cu km, with annual values normally and randomly distributed. Interannual variation totals--24.4 percent--was three-quarters of the value derived from measurements at individual stations with comparable rainfall. Two-thirds of the interannual variation was filtered by a 5-year running mean showing two long and relatively constant wetter than average spells between 1934 and 1954 and between 1965 and 1981, separated by a shorter but more pronounced dry spell from 1955 to 1964. There was no evidence for any significant cyclic or long-term trends in, or effects of, cloud seeding on the total annual volume of rain. The spatial distribution of annual rainfall was continuous, asymmetrical, and persistent; two-thirds of the total volume fell on the approximately one-third of the total area between the 300 and 800 mm isohyets. Within each rainfall zone, interannual variation increased with the rainfall and a correlation matrix showed that in half of the possible cases, changes in the area of a given zone were significantly correlated, either positively or negatively, with changes in the areas of other zones. (Author's abstract)
W89-11534

PRECIPITATION PATTERNS ASSOCIATED WITH THE HIGH INDEX PHASE OF THE SOUTHERN OSCILLATION.
National Environmental Satellite, Data, and Information Service, Washington, DC. Climate Analysis Center.
C. F. Ropelewski, and M. S. Halpert.
Journal of Climate JLCLEL, Vol. 2, No. 3, p 268-284, March 1989. 18 fig, 2 tab, 26 ref.

Descriptors: *Weather patterns, *Southern oscillation, *El Nino, *Climatology, *Rainfall, *Precipitation, *Atmosphere, *Air circulation, Tropical regions, Atmospheric physics, Gulf of Mexico, Meteorological data collection, Subtropic zones, Prediction.

The relationships are examined between precipitation and the high index phase of the Southern Oscillation (SO) for 19 regions of the globe that have documented low SO index-precipitation relationships. The study reveals that 15 of these regions also show evidence of characteristic precipitation anomalies during the high index phase of the SO. In each of the regions, the high SO index-precipitation relationships show the opposite sign of those documented for the low index phase. These precipitation relationships were consistent, holding for over 70 percent of the SO index years, and statistically significant. In particular, the high index phase of the SO is associated with enhanced precipitation for the monsoons of India and northern Australia as well as for the rainy seasons in northeastern South America and southeastern Africa. High SO index precipitation was found to be less than median in the central Pacific, Minicoy-Sri Lanka, eastern equatorial Africa, the Gulf of Mexico and northern Mexico region, and southeastern South America. The seasons that showed high SO index-precipitation relationships were almost identical to the seasons associated with the low index in 13 of the 15 high SO index regions. Thus, to a first approximation, this study suggests that the sign of the precipitation anomaly for these regions is linearly related to the phase of the SO. Since there are 25 low index and 19 high index years in the 109 yr analysis period, from 1875 to 1983, these results further suggest that, for over 40 percent of the years, precipitation may be classified and perhaps predicted on the basis of the extreme SO phase. (Author's abstract)
W89-11535

IMPROVED VALUES OF 1-HOUR M5 RAINFALLS FOR THE UNITED KINGDOM.
Meteorological Office, Bracknell (England).
B. R. May, and T. J. Hitch.
Meteorological Magazine MTMGA5, Vol. 118, No. 1401, p 41-44, April 1989. 5 fig, 4 ref.

Descriptors: *Rainfall, *Precipitation, *Rainfall distribution, *Rainfall-runoff relationships, *Excess rainfall, Flood peak, England, Meteorological data collection, On-site data collections, Weather patterns.

In 1975 the Flood Studies Report (FSR) (NERC 1975) was published, which contains recommended values for the rainfall amount that has a specified average interval (return period) between exceedances, as a function of duration and location in the United Kingdom. Previously existing M5 data sets have been enlarged with additional observations. This has enabled improved station values of the exceedance rainfall amount with a 5-yr return period (M5 rainfall) to be calculated and values for additional stations to be obtained. Evidence that would suggest that the FSR recommendations require amendment or improvement were sought. Values generated using the 'ITED' program, which are based on the FSR data and come from digitized, spatially interpolated 1-hr M5 rainfall for a specified location, were compared with May-Hitch ('MH') values, along with their standard errors calculated from the longer records from more stations. This comparison was made to determine the component of MH-FSR differences arising from the way corrections for standard error is applied. Results of the comparison showed that 1-hr M5 rainfall in southeast England (at least) has a more complicated structure than is indicated by the map in the FSR and its digitized version used in the ITED computer program. The FSR map probably oversmooths the original FSR station values on which it was based. The larger number of station values of 1-hr M5 rainfall now available allows a more detailed map for southeast England to be drawn directly without the use of supplementary data. (Friedmann-PTT)
W89-11536

MECHANISMS OF OROGRAPHIC PRECIPITATION.
Yale Univ., New Haven, CT. Dept. of Geology.
R. B. Smith.
Meteorological Magazine MTMGA5, Vol. 118, No. 1401, p 85-88, April 1989. 4 fig, 22 ref.

Descriptors: *Rainfall, *Precipitation, *Atmospheric physics, *Cloud physics, *Orographic precipitation, *Air circulation, Air-earth interfaces, Atmosphere, Rainstorms, Atmospheric water, Convection.

The four basic mechanisms thought to produce orographic rainfall in various climate zones of the world are reviewed. These mechanisms include smooth forced ascent, the Bergeron seeder-feeder cloud mechanism, diurnally forced convection and triggered convection by forced ascent or blocking. Smooth forced ascent can be a primary mechanism of precipitation on windward slopes in the subtropical high pressure belt where the descending branch of the Hadley cell discourages cloud formation, such as in the Canary Islands and coastal Queensland, Australia. The Bergeron mechanism produces an upper 'seeder' cloud, presumed to be precipitating with no influence from the terrain. Rain from the seeder is partly evaporated on the way to the earth's surface; this decreases the rainfall rate at the surface and serves to moisten the low-level air. When this air is locally lifted by the terrain, it reaches saturation quickly and a dense low-level cloud or fog is formed, the 'feeder' cloud. Diurnally forced convection occurs with daily heating of hillsides and mountain slopes, and contributes to thunderstorm formation east of the Rocky Mountains over the Great Plains, at night. Possible means by which terrain triggers convection by forced ascent include blocking and upstream lifting triggering deep convection, and blocking and different advection causing fronts to overturn, triggering conditional instability in stratiform layers. Degrees of possibility of finding each mechanism is reviewed for the tropics, subtropics and mid latitudes. (Friedmann-PTT)
W89-11537

WRITTEN IN THE WINDS: THE GREAT DROUGHT OF '88.
J. Namias.
Weatherwise WTHWA2, Vol. 42, No. 2, p 85-87, April 1989. 2 fig.

Descriptors: *Wind, *Drought, *El Nino, *Climatology, Air circulation, Air-water interfaces, Atmospheric physics, Arid climates, Weather, Water currents, Water temperature, Numerical analysis, Heat transfer, Upwelling.

The flow of upper-air prevailing winds over the northern hemisphere, as influenced by underlying sea surface temperatures, are reviewed for the summer of 1988 to explain the cause of the drought over much of the United States at that time. It is believed that unusually cold water along the equator and in the Pacific in spring and summer, a change following the 1986-87 El Nino, was associated with anomalously warm water to the north, near Hawaii and eastward. Such displacements could contribute to high pressure over and north of the warm pool of water, as in the summer of 1988. This high pressure area, in turn, could result in long-distance downwind effects, or teleconnections, to the drought cell over the Great Plains. This scenario is suggested by the results of some numerical experiments conducted after the summer drought, which suggest that the residual effects of El Nino might also assist in maintaining the drought-producing upper-level high pressure cell over the plains. While the reasons for the dramatic change in equatorial sea surface temperatures cannot be answered in detail, it is fairly certain that the direction and strength of winds along the equator are the cause due to their extraction of heat from the water and their ability to lessen the upwelling of cold subsurface water that usually takes place along the equator. (Friedmann-PTT)
W89-11538

RAINFALL VARIATION AND SOME IMPLICATIONS FOR FLOODING IN THE ALLAN CATCHMENT, CENTRAL SCOTLAND.
Southern Water Authority, Worthing (England). East Sussex Water and Drainage Div.
P. Rowling.
Weather WTHRAL, Vol. 44, No. 4, p 146-154, April 1989. 8 fig, 5 ref.

Descriptors: *Weather patterns, *Rainfall distribution, *Flood frequency, *Scotland, *Rainfall-runoff relationships, *Flood recurrence interval, Rainfall impact, Catchment areas, Watersheds, Floods, Hydrologic data collections, Flood control, Flood damage, Tidal effects, Land use.

The occurrence of what appears to be more frequent flooding in recent years at Bridge of Allan, Stirlingshire, Scotland, has aroused much local public interest. Records have shown flood frequency to have increased steadily from 1820 to 1929 and more dramatically over the past 15 years. In 1984, a flood prevention scheme, implemented in the late 1960s, was overtopped, leading to extensive property damage. The history of rainfall and

flooding in the Allan catchment are reviewed to determine the temporal changes that may have occurred. Rainfall-runoff relationships, rainfall changes, and flood changes, including frequency, magnitude, and seasonality, were analyzed for the River Allan catchment dating back to the early 1930s. Both rainfall totals and the magnitude and frequency of heavy rainfall at Bridge of Allan have fluctuated markedly during the past 55 years. Rainfall increased from the 1930s to 1950s, fell to the 1970s, and rose again to 1985, with the first and third highest recorded 24-h falls occurring in 1984 and 1985. The marked increase in total rainfall in the past ten years can almost totally be explained by the rapid rise in autumn rainfall, with the changes in heavy rainfall events accounting for those of overall totals. Flood data shows a fall in frequencies from 1958-71 and an increase from 1971-85, with the greatest peaks most sensitive to changes in autumn and winter rainfall events. The investigation found no evidence that tidal effects and the negligible land-use changes that have taken place within the catchment are to blame for the increased flooding; rather, the flood increase is due to an increase in heavy rainstorm frequency (> 20 mm). (Friedmann-PTT)
W89-11566

INCIDENT OF CLEAR AIR PRECIPITATION,
Meteorological Service, Wellington (New Zealand).
G. W. Fisher, and A. M. Bromley.
Weather WTHRAL, Vol. 44, No. 4, p 155-159, April 1989. 3 fig, 9 ref.

Descriptors: *Precipitation, *Ice, *Atmospheric water, *Ice formation, Rainfall, Condensation, Freezing, Polar regions, Antarctica.

Many observations have been made of the phenomenon of 'clear air precipitation,' particularly in polar regions. The term seems to be applied mainly to the precipitation of small ice crystals falling from apparently clear, cloudless skies. This occurs in cold climates. A case of clear air precipitation is reported that occurred under conditions that were neither very cold nor near open water that would normally allow homogeneous nucleation. The event was observed at a field site in the Windless Bight region on the ice shelf south of Ross Island, Antarctica, on the morning of 28 December 1986, the middle of the southern summer season. From horizon to horizon, there was no detectable cloud or haze layer. This event was unusual in that there were a number of features different from those in previously reported events: the 'shower' was first noted at 9 a.m. and lasted at least 4 hours; the ice crystals were large, many up to 1 mm across, and thus falling out rapidly; the temperature was not especially low, minus 10 to minus 14 C, at the surface, and warmer aloft. The event is explained rapid radiational cooling of saturated air in the lowest 400 m of the atmosphere, causing a supersaturated layer that began precipitating ice crystals directly. The event was simply a case of a very tenuous cloud, in which the individual particles were widely spaced and favored to the extent that they could grow by vapor deposition until large enough to fall out. (Friedmann-PTT)
W89-11567

RELATING POINT TO AREA AVERAGE RAINFALL IN SEMIARID WEST AFRICA AND THE IMPLICATIONS FOR RAINFALL ESTIMATES DERIVED FROM SATELLITE DATA.
Reading Univ. (England). Dept. of Meteorology.
I. D. Flitcroft, J. R. Mildford, and G. Dugdale.
Journal of Applied Meteorology JAMOAX, Vol. 28, No 4, p 252-265, April 1989. 11 fig, 1 tab, 8 ref.

Descriptors: *Africa, *Satellite technology, *Data interpretation, *Rainfall, *Rainfall distribution, *Meteorological data collection, *Semiarid climates, Model studies, Precipitation, Arid climates, Estimating, Rain gages, Niger, Correlation analysis, Regression analysis, Error analysis.

The variability of rainfall over small areas (100 sq km) in the West African Sahel has been investigated using a dense network of rain gages in the Republic of Niger. Rainfall was as well or better correlated over small distances as rainfall in other semiarid climates. A regression model was developed to specify the systematic correction required, when a rain gage measurement is used to represent an area average rainfall and to quantify the errors involved. It was found that in this particular climate, large point measurements are not representative of even small areas and need to be reduced by a factor that depends on the size of the area. Rainfall estimates based on satellite observations often use point rainfall to calibrate and validate estimates of area average (pixel) rainfall. Satellite location errors affect the correct pairing of point measurements and pixel estimates which, in turn, affect the assessment of the accuracy of rainfall estimates based on satellite data. Satellite measurements are area average quantities and have different frequency distributions to point measured quantities. Methods of rainfall estimation using satellite data, which are calibrated by rain gage data, should use a transformation of the point rainfalls to compare them with the satellite data over the area of the pixel. When an estimate of area average rainfall, derived by whatever means, is validated by comparing the area value with a point measurement, there will be an irreducible scatter in the relationship. The satellite collocation errors are not well-defined and the distribution of collocation errors that is assumed changes the root-mean-square error of regression substantially. (Friedmann-PTT)
W89-11579

IMPACT OF SUMMER RAINFALL ON THE TEMPERATURE GRADIENT ALONG THE UNITED STATES-MEXICO BORDER,
Arizona State Univ., Tempe. Lab. of Climatology.
R. C. Balling.
Journal of Applied Meteorology JAMOAX, Vol. 28, No 4, p 304-308, April 1989. 2 fig, 3 tab, 18 ref. Jet Propulsion Laboratory Contract 957872.

Descriptors: *Vegetation, *Grazing, *Rainfall, *Precipitation, *Air-earth interfaces, *Albedo, *Temperature gradient, Temperature, Mexico, Arizona, Evapotranspiration, Seasonal variation, Air temperature, Deserts.

The international border running through the Sonoran Desert in southern Arizona and northern Sonora is marked by a sharp discontinuity in albedo and grass cover. The observed differences in surface properties are a result of long-term, severe overgrazing of the Mexican lands. Recently, investigators have shown the Mexican side of the border to have higher surface and air temperatures when compared to adjacent areas in the United States. The differences in temperatures appear to be more associated with differential evapotranspiration rates than with albedo changes along the border. The impact of summer rainfall on the observed seasonal and daily gradient in maximum temperature was examined. On a seasonal time scale, the temperature gradient increases with higher moisture levels, probably due to a vegetative response on the United States side of the border; at the daily level, the gradient in maximum temperature decreases after a rain event as evaporation rates equalize between the countries. The results suggest that temperature differences between the vegetated and overgrazed landscapes in arid areas are highly dependent upon the amount of moisture available for evapotranspiration. (Author's abstract)
W89-11580

SUMMER MONSOON OF 1987,
Florida State Univ., Tallahassee. Dept. of Meteorology.
T. N. Krishnamurti, H. S. Bedi, and M. Subramaniam.
Journal of Climate JLCLEL, Vol. 2, No. 4, p 321-340, April 1989. 14 fig, 21 ref. NSF Grant NSF ATM 8304809, NOAA Grant NA 85 AA-H-CA019.

Descriptors: *Drought, *India, *Monsoons, *Climatology, *Air-water interfaces, Radiation, Air circulation, Water currents, Convection, Rainfall, Atmosphere.

The evolution of a number of parameters have been examined that are believed to be important for understanding the drought over India during the summer of 1987. The list of parameters includes monthly means or anomalies of the following fields: sea surface temperature, divergent circulations, outgoing longwave radiation, streamfunction of the lower and upper troposphere, and monthly precipitation (expressed as a percentage departure from a long-term mean). The El Nino related warm sea surface temperature anomaly and a weaker warm sea surface temperature anomaly over th equatorial Indian Ocean provide sustained convection, as reflected by the negative values of the outgoing longwave radiation. With the seasonal heating, a pronounced planetary-scale divergent circulation evolved with a center along the western Pacific Ocean. The monsoonal divergent circulation merged with that related to the El Nino, maintaining most of the heavy rainfall activity between the equatorial Pacific Ocean and east Asia. Persistent convective activity continued south of India during the entire monsoon season. Strong Hadley type overturnings with rising motions over these warm SST anomaly regions and descent roughly near 20 degrees to 25 degrees S was evident as early as April 1987. The subtropical high pressure areas near 20 degrees to 25 degrees S showed stronger than normal circulations. This was revealed by the presence of a counterclockwise streamfunction anomaly at 850 mb during April 1987. With the seasonal heating, this anomaly moved northwards and was located over the Arabian Sea and India. This countermonsoon circulation anomaly at the low levels was associated with a weaker than normal Somali jet and Arabian Sea circulation throughout this summer. The monsoon remained active along northeast India, Bangladesh, northern Indochina, and central China during the summer monsoon season. This was related to the eastward shift of the divergent circulation. An eastward shift of the upper tropospheric anticylcone belt near 25 degrees to 30 degrees N resulted in the continued presence of a westerly wind anomaly north of India. The westerly winds brought in very dry air over the tropical upper troposphere, and this seemed to have a major role in inhibiting organized deep convection over most of the Indian subcontinent. (Author's abstract)
W89-11581

LARGE-SCALE PRECIPITATION AND OUTGOING LONGWAVE RADIATION FROM INSAT-1B DURING THE 1986 SOUTHWEST MONSOON SEASON.
National Environmental Satellite, Data, and Information Service, Washington, DC. Climate Analysis Center.
P. A. Arkin, A. V. R. Krishna Rao, and R. R. Kelkar.
Journal of Climate JLCLEL, Vol. 2, No. 6, p 619-628, June 1989. 5 fig, 1 tab, 17 ref.

Descriptors: *Satellite technology, *Monsoons, *Climatology, *Meteorological data collection, *Precipitation, *Radiation, Rainfall, India, Indonesia, Satellites, Orographic precipitation.

Areally averaged precipitation and broadband outgoing longwave radiation (OLR) have been estimated from infrared window channel observations from INSAT-1B, the Indian geostationary satellite, for the period June-September 1986. The estimation techniques used were identical with those contained in previously published work using GOES (for precipitation) and NOAA (for OLR) satellite data. The fields of estimated monthly mean precipitation and OLR are quite similar, with regions of low flux corresponding to areas of heavy precipitation. Two bands of heavy rainfall were found, one near the equator, possibly associated with the ITCZ, and another extending northwestward from Indonesia through the Bay of Bengal and over India. This latter feature exhibited a pronounced southeastward retreat during the course of the season. The rainfall estimates were reasonably consistent in both distribution and magnitude over India with climatological mean fields derived from rain gauge measurements. The OLR is similar in distribution but is about 5-10 W /sq m less in magnitude over land than that derived from

observations from NOAA polar-orbiting satellites. Comparisons between weekly estimated rainfall and station rainfall observations show that the quantitative relationships between cloudiness and rainfall found in previous work are confirmed over most of India. An area along the west coast, where orographic rainfall is important, exhibits much higher correlations when a cloud top temperature of 265 or 270 K is used as the upper threshold for precipitation instead of 235 K. (Author's abstract)
W89-11582

PERIODIC VARIATIONS IN EXTREME HOURLY RAINFALLS IN THE UNITED KINGDOM.
Meteorological Office, Bracknell (England).
B. R. May, and T. J. Hitch.
The Meteorological Magazine MTMGA5, Vol. 118, No. 1400, p 45-50, March 1989. 6 fig, 6 ref.

Descriptors: *Precipitation, *Rainfall, *Rainstorms, *Cloudbursts, *Rainfall intensity, *Rainfall-runoff relationships, Flood control, Flood frequency, England, Urban runoff.

The behavior of annual maximum 1-h rainfalls were observed at many locations in the United Kingdom during the period 1881-1986. These rainfall frequencies of occurrence over a long period were compared against the frequencies recommended in the Flood Studies Report, Volume II, 1975, which were based on observations over a shorter period, 1951-1970. It was found that annual maximum 1-h duration rainfalls observed during the interval 1881-1986 over the whole of the U.K. appear to have four main components, approximately sine wave in shape, with periods of about 7, 11, 20 and 50 years and mean amplitudes of 7, 10, 5, and 7 percent. The two longer period components have decreased considerably in size since about 1935 and are now nearly undetectable; however, two shorter period components have decreased in size only slightly. The maxima of the shorter, 11-yr period wave have repeated strongly throughout the interval covered by the observations, and are closely synchronized with the maxima of the solar activity cycle. These observations are of practical relevance because large 1-hr rainfalls are important in causing flood events in some urban catchments with a response time of about this duration and have an impact on the design of flood control structures and the risk of their failure. (Friedmann-PTT)
W89-11583

BACKGROUND TRENDS OF PH OF PRECIPITATION OVER INDIA.
Meteorological Office, Poona (India).
G. S. Varma.
Atmospheric Environment ATENBP, Vol. 23, No. 4, p 747-751, April 1989. 6 fig, 2 tab, 18 ref.

Descriptors: *Chemistry of precipitation, *Acid rain, *Hydrogen ion concentration, *India, Air pollution, Monitoring, Aerosols, Calcium, Magnesium, Sodium, Potassium, Baseline studies.

Background trends of rainwater pH have been examined at ten Indian Background Air Pollution Monitoring stations for the period 1974-1984. The highest frequency of pH was observed in the range 6.5-7.0. The 621 pH values recorded were all lying between 5.18 and 9.00. At most of the stations the pH trend is decreasing towards the acid range. The overall probability of occurrence of acid rain was found to be about 2% (pH $<$ 5.6). Very high pH values have also been observed at some stations, especially at Jodhpur, Allahabad and Srinagar, due to incursions of soil particles rich in Ca(2+), Mg(2+), Na(+), and K(+) ions. The soil-derived aerosols from the Rajasthan desert are mainly responsible for high pH values in northwest India. In a clean dust free environment the pH values of precipitation do not differ much and are in the range of 6.7-6.8. (Author's abstract)
W89-11610

LONG-TERM EFFECTS OF POLLUTANTS ON PH OF RAIN WATER IN NORTH INDIA.
Indian Inst. of Tropical Meteorology, Poona.
For primary bibliographic entry see Field 5B.
W89-11611

ANALYSIS OF ALDEHYDES IN CLOUD--AND FOGWATER SAMPLES BY HPLC WITH A POSTCOLUMN REACTION DETECTOR.
California Inst. of Tech., Pasadena. W.M. Keck Engineering Lab. of Hydraulics and Water Resources.
For primary bibliographic entry see Field 5A.
W89-11619

RAINDROP CHARACTERISTICS IN THE HUMID TROPICS.
Ibadan Univ. (Nigeria). Dept. of Agricultural Engineering.
G. E. Osuji.
Journal of Environmental Management JEVMAW, Vol. 28, No. 3, p 227-233, April 1989. 4 fig, 13 ref.

Descriptors: *Rain, *Tropical regions, *Nigeria, *Drop size, *Humid climates, Rainfall intensity, Kinetic energy, Universal Soil Loss Equation, Particle size.

Raindrop characteristics in the humid tropics were studied in Ibadan, southwestern Nigeria, using the flour pellet method. Results show drop sizes ranging from a minimum of 0.09 mm to a maximum of 5.46 mm in diameter. Drop sizes from 2.0-3.5 mm diameter were predominant in most rainfall events. Median drop sizes (D50) increased with increasing rainfall intensities up to about 110 mm per hour, then decreased as intensities increased to about 180 mm per hour. Thereafter, median drop sizes increased again, thus indicating a cyclic relationship. There is no correlation between median drop size and maximum intensity calculated at 5, 10,15, 30, and 45 minute intervals. The maximum intensity during the study period was 235 mm per hour. The kinetic energy-intensity relationship follows the same trend as the drop size-intensity relationship. The maximum energy load recorded during the study was much higher than energy loads reported for temperate storms. Even at lower intensities, the rainfall kinetic energy values in this study were found to be higher than those used currently in the Universal Soil Loss Equation. Because humid tropical storms are characterized by large drop sizes and high intensities, their kinetic energy and intensity relationship is much higher than that used in the Universal Soil Loss Equation. (Author's abstract)
W89-11626

STOCHASTIC CLUSTER MODEL FOR HOURLY PRECIPITATION DATA,
Oregon State Univ., Corvallis. Dept. of Agricultural Engineering.
J. D. Istok, and L. Boersma.
Journal of Hydrology JHYDA7, Vol. 106, No. 3/4, p 257-285, April 20 1989. 11 fig, 6 tab, 23 ref.

Descriptors: *Meteorology, *Statistical methods, *Stochastic models, *Model studies, *Regression analysis, *Precipitation, *Rainfall intensity, Meteorological data collection, Poisson ratio, Monte Carlo method, Climatology, Correlation analysis.

A stochastic model of hourly precipitation was developed that preserves the pattern of occurrence of precipitation events throughout the year as well as several characteristics of the duration, amount, and intensity of precipitation within events. In the developed model, the pattern of occurrence of precipitation events is described by a Poisson cluster process. The duration of events and the time between events within clusters are described with identical Logarithmic Negative Mixture distributions. The hourly precipitation amounts within events are described with a nonstationary, first-order autoregression model. The results of Monte Carlo simulations for Salem and Pendleton, Oregon (stations from very different climatic regimes) showed that the model accurately reproduces the seasonal pattern of event occurrence and the marginal and conditional distributions of the magnitude, duration, and intensity of precipitation during events. Autocorrelation functions for the historical and simulated data were also similar. (Author's abstract)
W89-11680

ANALYSIS OF A SURFACE FRONT DURING THE EARLY SUMMER RAINY SEASON OVER TAIWAN.
Hawaii Univ., Honolulu. Dept. of Meteorology.
Y. Chen, Y. Zhang, and N. B. Hui.
Monthly Weather Review MRWEAB, Vol. 117, No. 5, p 909-931, May 1989. 21 fig, 23 ref.

Descriptors: *Meteorology, *Weather, *Weather patterns, *Rainfall, *Taiwan, Precipitation, Cloud cover, Case studies, Air circulation, Air-earth interfaces, Atmosphere, Heat transfer.

A case study of a relatively dry front during TAMEX IOP-4 is presented. At 0000 UTC 27 May, the broad cloud band extended from the China plain and southern Japan to east of 150 degrees E, along and north of the surface front. This front possesses appreciable baroclinicity. As the midtropospheric trough moved eastward, the surface front advanced southeastward and eventually separated from the quasi-stationary cloud band. The depth of the cold air decreased as it penetrated to the subtropics. In the vicinity of Taiwan, the frontal surface was shallow with a depth of about 1 km. The convection occurred in two different regimes: the large-scale cloud band associated with the eastward-moving trough, and cumuli along the surface front. As the surface front approached Taiwan, the southwest flow started to increase, and a mesolow formed over the southeastern coast due to the interaction between the southwest flow and the mountainous topography. The air moved over the mountains and descended adiabatically. During the frontal passage, the mesolow deepened as the approaching front from the north also became a flow barrier. After the frontal passage, the mesolow was filled by the advancing cold air. As the mesolow in southeastern Taiwan filled, a new mesolow formed over the southwestern plain. The surface front and isobars were distorted during the frontal passage as the shallow cold air moved around the topography. The relatively low pressure over the southwestern plain resulted hydrostatically from the cold air behind the front not reaching the southwestern plain, while surrounding areas experienced rising pressure with the arrival of the cold air. (Author's abstract)
W89-11685

FURTHER FGGE FORECASTS FOR AMAZON BASIN RAINFALL.
Universidade Federal do Rio de Janeiro (Brazil). Dept. of Meteorology.
J. Paegle, L. Buja, and R. E. Dickinson.
Monthly Weather Review MRWEAB, Vol. 117, No. 5, p 1093-1102, May 1989. 7 fig, 15 ref. NSF Grants INT 8602690 and ATM 8611952; University of Utah Grant CNPq. Process n 40.2595/86 in Brazil.

Descriptors: *River basins, *Meteorology, *Rainfall, *Amazon River, *Weather forecasting, Weather patterns, Air circulation, Tropical regions, Hydrologic cycle, Atmosphere, Air-water interfaces, Heat transfer, Precipitation, Rain forests.

A series of experiments using real-data general circulation model integrations was performed to study the impact of remote tropical Pacific heating modifications upon the rainfall over the Amazon Basin. In one set of experiments, a heating term is added to the thermodynamic equation in the western tropical Pacific ocean, and in the second set, the sea surface temperatures are cooled in the eastern Pacific Ocean. The rainfall of northern sections of South America decreases in the first set of experiments and increases in the second set of experiments. Examination of the circulation changes for the second set of experiments suggests that the remote links occur through equatorially trapped flow modifications, perhaps related to the east-west Walker cells, rather than through midlatitude teleconnections via Hadley cells. The time

evolution of these patterns suggest them to be clearly relevant for medium range weather prediction in the tropics. (Author's abstract)
W89-11686

TREE RING ANALYSIS OF SURPLUS AND DEFICIT RUNOFF IN THE WHITE RIVER, ARKANSAS.
Arkansas Univ., Fayetteville. Dept. of Geography.
For primary bibliographic entry see Field 2E.
W89-11778

EXTREME PRECIPITATION EVENTS GENERATED BY PERIODIC PROCESSES.
Florida Univ., Gainesville. Dept. of Statistics.
R. Ballerini, and P. Waylen.
Water Resources Research WRERAO, Vol. 25, No. 6, p 1403-1411, June 1989. 16 fig, 29 ref.

Descriptors: *Meteorology, *Florida, *Rainfall, *Statistics, *Hydrologic models, *Probable maximum precipitation, Maximum daily precipitation, Model studies, Simulation, Time series analysis, Frequency distribution.

A procedure for the estimation of large quantile daily precipitation totals draws on the statistical properties of extremes generated by processes with periodic variances. Forty-one years of records at Homestead, Florida, are used to calibrate the model and are incorporated into the simulation procedure that compares the proposed technique to standard methods of analyzing annual series. Results indicate that the procedure yields reasonable estimates of large quantile precipitation and performs as reliably, or more so, than the standard techniques. The empirical maximum daily precipitation totals at 12 sites in Florida were compared with the asymptotic distribution of maximum daily precipitation generated by the new procedure. Each of the sites had more than 40 yr of records. The asymptotic distribution consistently underestimates the quantile by 25-50 mm, but the shapes of distributions are subparallel. The physical and theoretical bases of the procedure were maintained throughout the study. (Author's abstract)
W89-11779

CONDITIONING STOCHASTIC DAILY PRECIPITATION MODELS ON TOTAL MONTHLY PRECIPITATION.
Cornell Univ., Ithaca, NY. Dept. of Agronomy.
D. S. Wilks.
Water Resources Research WRERAO, Vol. 25, No. 6, p 1429-1439, June 1989. 8 fig, 2 tab, 31 ref, append. USDA Hatch Project 430.

Descriptors: *Meteorology, *North America, *Hydrologic models, *Precipitation, *Hydrologic data collections, Model studies, Mathematical models, Sampling, Climates, Palmer Moisture Anomaly, Palmer Hydrological Drought Index, Stochastic process.

Chain-dependent stochastic daily precipitation models were fit to dry, near-normal, and wet subsets of monthly total precipitation data, using category definitions consistent with the 30-day forecasts issued by the Climate Analysis Center of the National Oceanic and Atmospheric Administration. The resulting models were compared to those derived unconditionally from entire records. For the 10 selected North American stations investigated, the unconditional models produced distributions of total monthly precipitation having too few dry and wet months compared to observations, whereas appropriate probability mixtures of the three conditional models can reproduce accurately the climatological distributions of total monthly precipitation. Application of the conditional precipitation models to generation of daily data consistent with certain longer-term aspects of the observations is illustrated by simulation of the Palmer Moisture Anomaly (Z) Index and the Palmer Hydrological Drought Index. (Author's abstract)
W89-11782

DROUGHT INDICATED IN CARBON-13/CARBON-12 RATIOS OF SOUTHWESTERN TREE RINGS.
Wisconsin Univ.-Parkside, Kenosha. Dept. of Geology.
For primary bibliographic entry see Field 7B.
W89-11796

NUTRIENT CONTENT OF BULK PRECIPITATION IN SOUTH-CENTRAL JAVA, INDONESIA.
Vrije Univ., Amsterdam (Netherlands). Dept. of Hydrogeology and Geographical Hydrology.
For primary bibliographic entry see Field 2I.
W89-11820

OBJECTIVES ASSESSMENT OF 1984-85 VAS PRODUCTS AS INDICES OF THUNDERSTORM AND SEVERE LOCAL STORM POTENTIAL.
National Weather Service, Silver Spring, MD. Techniques Development Lab.
D. H. Kitzmiller, and W. E. McGovern.
Available from the National Technical Information Service, Springfield, VA 22161, as PB89-107668. Price codes: A03 in paper copy, A01 in microfiche. NOAA Technical Memorandum NWS TDL 78, March 1988. 38p, 20 fig, 3 tab, 34 ref.

Descriptors: *Radiometry, *Weather forecasting, *Measuring instruments, *Thunderstorms, *Storms, *Atmospheric physics, Radiosondes, Mathematical models, Forecasting, Prediction, Correlation analysis, Infrared imagery, Performance evaluation.

Objective experiments have been carried out to determine which Visible and Infrared Spin Scan Radiometer Atmosphere Sounder (VAS)-derived moisture and stability indices contain the greatest amount of predictive information with respect to thunderstorm and severe local storm events. In these experiments, stability and moisture parameters derived from 1700 GMT VAS retrievals were compared and correlated to storm observations during the subsequent 2000-0000 GMT period. The amount of predictive information in these indices was also compared to that possessed by indices derived from VAS retrievals taken earlier in the day, and from concurrently-available radiosondes and numerical model forecasts. The correlation in the form of the computed information ratio (I sub c) was used as a measure of predictive power in these experiments. It was found that precipitable water and modified versions of the classic K index which included the latest surface data have the highest values of I sub c for general thunderstorm occurrence. It was also found that updating of stability measurements leads to modest increases in predictive information. (Lantz-PTT)
W89-12078

WINTER CLOUD SEEDING POTENTIAL ON THE MOGOLLON RIM.
Bureau of Reclamation, Denver, CO. Div. of Research and Lab. Services.
For primary bibliographic entry see Field 3B.
W89-12090

HEAVY SNOWFALL IN NORTHWEST WYOMING.
National Weather Service Forecast Office, Cheyenne, WY.
For primary bibliographic entry see Field 2C.
W89-12107

2C. Snow, Ice, and Frost

HYDROGEOLOGIC FACIES MODELS TO DELINEATE LARGE-SCALE SPATIAL TRENDS IN GLACIAL AND GLACIOFLUVIAL SEDIMENTS.
Wisconsin Univ.-Madison. Dept. of Geology and Geophysics.
For primary bibliographic entry see Field 2J.
W89-11302

CHEMICAL CHARACTERISTICS AND SUSPENDED SEDIMENT LOAD OF MELTWATERS FROM A HIMALAYAN GLACIER IN INDIA.
Jawaharlal Nehru Univ., New Delhi (India). School of Environmental Sciences.
For primary bibliographic entry see Field 2K.
W89-11376

INCIDENT OF CLEAR AIR PRECIPITATION,
Meteorological Service, Wellington (New Zealand).
For primary bibliographic entry see Field 2B.
W89-11567

EVIDENCE OF ATMOSPHERIC TRANSPORT AND DEPOSITION OF ORGANOCHLORINE PESTICIDES AND POLYCHLORINATED BIPHENYLS IN CANADIAN ARCTIC SNOW.
Environmental Protection Service, Regina (Saskatchewan). Water Quality Branch.
For primary bibliographic entry see Field 5B.
W89-11620

EFFECT OF SNOWMELT ON THE HYDROGEN ISOTOPE RATIOS OF CREEK DISCHARGE IN SURPRISE VALLEY, CALIFORNIA,
California Univ., Davis. Dept. of Geology.
N. L. Ingraham, and B. E. Taylor.
Journal of Hydrology JHYDA7, Vol. 106, No. 3/4, p 233-244, April 20 1989. 8 fig, 1 tab, 18 ref.

Descriptors: *Tracers, *Isotopic tracers, *Surface-groundwater relations, *Hydrogen isotopes, *California, *Water chemistry, *Rainfall-runoff relationships, *Snowmelt, *Isotope studies, Snow, Stream discharge, Sampling, Chemical analysis, Water analysis, Streams, Hydrogen.

Snow and creek samples were collected in Surprise Valley, California, to determine the effect of precipitation and snowmelt on the stable isotopic composition of creek discharge. The hydrogen isotope ratios of ten snow cores collected in late April 1983 displayed differences of up to 17 ppt, and averaged about minus 110 ppt. Sampling of four creeks was performed monthly, commencing two weeks after the snow cores were taken, and continuing for eight months. The creek samples showed remarkable consistency and similarity in their hydrogen isotope ratios, which averaged minus 104 ppt. Total differences of only 8 ppt were observed between all creek samples collected, and variation within any one creek was less than 5 ppt. The consistency of the hydrogen isotope ratios of the creek samples is attributed to the dominance of groundwater in the creek discharge. Variations are shown to be directly related to the influx of meltwater during peak spring flows or rain events. (Author's abstract)
W89-11677

FRAMEWORK FOR CONTROL OF DYNAMIC ICE BREAKUP BY RIVER REGULATION.
Cold Regions Research and Engineering Lab., Hanover, NH.
For primary bibliographic entry see Field 4A.
W89-11699

HEAVY SNOWFALL IN NORTHWEST WYOMING.
National Weather Service Forecast Office, Cheyenne, WY.
M. S. Weiland.
Available from the National Technical Information Service, Springfield, VA 22161, as PB89-109524. Price codes: A03 in paper copy, A01 in microfiche. NOAA Technical Memorandum NWS CR-91, September 1988. 31p, 24 fig, 2 ref.

Descriptors: *Snow, *Snow accumulation, *Meteorological data collection, *Wyoming, Meteorology, Climatology, Wind, Temperature, Orographic precipitation.

Heavy snowfall in the northwest part of Wyoming is a significant part of annual precipitation. A climatology of heavy snow events for northwest

Wyoming is given. Results indicate that the orientation of the flow aloft to the mountains is very important. In heavy snow situations winds at or above 700 millibar (mb) blow perpendicular to the mountains at speeds of 30 knots or greater. Temperatures typically range from -6 to -8 C at 700 mb, and -26 to -28 C at 500 mb. Saturated vertical ascent due to orographic lift was also noted in most cases. (Author's abstract)
W89-12107

GLACIATED COASTS.
Boston Univ., MA. Dept. of Geology.
For primary bibliographic entry see Field 2J.
W89-12118

GEOMORPHOLOGY OF A TECTONICALLY ACTIVE, GLACIATED COAST, SOUTH-CENTRAL ALASKA.
Maryland Univ., Cambridge. Horn Point Environmental Labs.
For primary bibliographic entry see Field 8E.
W89-12119

2D. Evaporation and Transpiration

VERIFIABLE EVAPORATION MODELING ON THE LAURENTIAN GREAT LAKES.
National Oceanic and Atmospheric Administration, Ann Arbor, MI. Great Lakes Environmental Research Lab.
T. E. Croley.
Water Resources Research WRERAO, Vol. 25, No. 5, p 781-792, May 1989. 2 fig, 3 tab, 28 ref.

Descriptors: *Hydrologic cycle, *Great Lakes, *Hydrologic models, *Evaporation, *Lake evaporation, *Heat transfer, Heat budget, Energy, Water temperature, Lakes, Surface water, Model studies, Statistical analysis, Calibrations, Water temperature.

Water or energy balance estimates of Great Lakes evaporation require storage change data, not available in simulations or forecasts, and errors in the components of the balances are summed in the residual, giving large estimation errors. Neither these balance estimates nor evaporation models, which use the aerodynamic equation with mass transfer coefficients can be verified, since independent estimates of evaporation are not available with sufficient accuracy. However, water surface temperatures can be used to verify energy budgets. The mass transfer coefficient research is combined with lumped concepts of classical energy conservation and a new superposition heat storage model to provide continuous simulation capability of both water surface temperatures and lake evaporation for use in outlooks and forecasts of lake levels. The model is calibrated with surface temperatures for four of the Great Lakes and Lake St. Clair. This heat storage model is a superposition model where the latest heat additions to the lake are first removed. The model, when used with contemporary treatments of evaporation and heat exchange, appears to do a good job of replicating average areal surface temperatures and heat fluxes on the deep lakes. Correlations between model and remotely observed average areal surface temperatures are 0.97-0.99 during the calibration period of 1979-1985 and range from 0.93 to 0.98 during a verification period of 1966-1978. The corresponding root-mean-square errors are 1.2-1.5 C for the calibrations and 1.3-1.6 C for the verification periods. These errors compared favorably with reported accuracies for reduction of remotely sensed data. (Friedmann-PTT)
W89-11249

ATMOSPHERIC EVAPORATIVE DEMAND AND EVAPORATION COEFFICIENT CONCEPTS.
Orange Free State Univ., Bloemfontein (South Africa). Dept. of Agrometeorology.
J. M. de Jager, and W. H. van Zyl.
Water SA WASADV, Vol. 15, No. 2, p 103-110, April 1989. 31 ref.

Descriptors: *Evaporation, *Evaporation rate, *Evapotranspiration, *Model studies, Irrigation requirements, Hydrologic models, Atmospheric evaporative demand, Water vapor, Vegetation, Soil water, Energy, Soil-water-plant relationships, Vegetation effects, Lysimeters.

An improved, generally applicable, and fundamental definition of the upper limit to the rate of evaporation created by atmospheric driving forces is needed. The relevant driving forces are radiation, wind, and atmosphere temperature and humidity. Four different conceptualizations of upper limit evaporation from vegetated surfaces are daily reference plant evaporation (E sub o), basal plant evaporation (E sub vm), maximum total evaporation (E sub m), and potential total evaporation (E sub p). Each of these represents a special case of the upper limit of water loss rate from a natural surface. Evaporation from a vegetated surface must be considered in terms of two components: soil evaporation and canopy transpiration. The crop coefficient also consists of two corresponding coefficients, which must be separately determined. To regularize upper limit evaporation from natural vegetation, the concept 'atmospheric evaporative demand' (AED) was defined. The AED is defined as the water vapor transfer to the atmosphere required to sustain the energy balance of a given vegetative surface, in its present growth stage, when the water status of its root zone permits unhindered plant evaporation and the water status of the top 150 mm of soil equals its current value. This definition both acknowledges the dominant influence of the atmospheric conditions and basically accounts for crop type, crop growth stage, and soil surface water content. Inclusion of the phrases 'sustain the energy balance of a given vegetative surface in its present growth stage' and 'water status of the top 150 mm of soil equals its current value' make the AED completely general and applicable in all possible situations. Furthermore, it covers all the special cases represented by E sub o, E sub vm, E sub m, and E sub p. Its main advantage lies in it its precise quantification of the true water requirement for irrigated crops in given climates. For practical irrigation scheduling and hydrological and crop growth modeling, AED represents the true water consumption by a cropped surface that has not experienced yield losses due to water deficiency. AED can be evaluated in two ways: (1) direct measurement by lysimeter, which is expensive, but well understood, and (2) estimation of the special case of AED called E sub o, followed by multiplication of this value by an appropriate crop coefficient. (Rochester-PTT)
W89-11746

ADDITION OF A CLIMATE VARIABLE TO THE HOWE AND LINAWEAVER WESTERN SPRINKLING EQUATION.
Wilson (Lee) and Associates, Inc., Santa Fe, NM.
For primary bibliographic entry see Field 3D.
W89-11750

2E. Streamflow and Runoff

MEASURING DROUGHT IMPACTS: THE ILLINOIS CASE.
Illinois State Water Survey Div., Champaign. Climatology and Meteorology Section.
S. A. Changnon, and W. E. Easterling.
Water Resources Bulletin WARBAQ, Vol. 25, No. 1, p 27-42, February 1989. 5 fig, 5 tab, 13 ref. NSF grant ATM-8413043, NOAA grant COMM NA8711-D-CP119.

Descriptors: *Surface water availability, *Drought, *Streamflow, *Reservoirs, *Wells, *Groundwater availability, *Water supply, Social impact, Economic impact.

Drought is an interaction between physical processes and human activities. This study quantified the impacts of precipitation deficiencies on streamflow, reservoirs, and shallow groundwater supplies. An in-depth analysis of newspaper accounts of droughts between paired cities, one in drought and one not in drought, were used to measure the differences in the types of drought impacts, and in the time of onset of impacts as related to developing precipitation deficiencies. Precipitation deficiencies related to the onset and the magnitude of surface water supply adjustments, and to shallow groundwater problems, were established. Thus, monitoring and prediction of the onset and magnitude of drought problems can now be done from readily available data on precipitation deficiencies. Newspapers were found to be reliable indicators for the timing of drought impacts and adjustments as precipitation deficiency develops. A review of local and state adjustments during two recent droughts revealed most decision makers lacked information and experience in dealing with droughts. (Author's abstract)
W89-11158

STORM RUNOFF CHARACTERISTICS OF GRAZED WATERSHEDS IN EASTERN OREGON.
Chequamegon National Forest, Park Falls, WI.
D. A. Higgins, S. B. Maloney, A. R. Tiedemann, and T. M. Quigley.
Water Resources Bulletin WARBAQ, Vol. 25, No. 1, p 87-100, February 1989. 2 fig, 12 tab, 32 ref.

Descriptors: *Rainfall-runoff relationships, *Forest watersheds, *Storm runoff, *Flood peak, *Grazing, *Vegetation effects, *Range management, Hydrographs, Oregon.

Rainfall and runoff data from 485 storms during the summers of 1979-84 were evaluated to characterize storm runoff volumes (SF) and peak flows (QP) for 13 small watersheds in the Blue Mountains of eastern Oregon and to determine differences among grazing intensities and vegetation types. Storm hydrographs were separated by using watershed-specific baseflow rise rates of 0.002-0.013 cfsm/hr. Median SF and QP were 0.0014 in and 0.43 cfsm, respectively, for all storms. Total storm rainfall (PPT) and initial flow (QI) were important stepwise regression variables in accounting for the variation in SF and peak flow above initial flow (QPI); 30-min andin rainfall intensities and rainfall duration were relatively unimportant. Two classes of vegetation were evaluated: (1) western larch-Douglas-fir (9 watersheds), and (2) other (4 watersheds representing fir-spruce, lodgepole pine, mountain meadow, and ponderosa pine). Mean SF and QP did not differ ($P=0.05$) among vegetation classes but significant differences were apparent in the relation of SF to PPT and QI, and QPI to PPT and QI. As PPT and QI increased, SF and QPI from larch-Douglas-fir watersheds increased at a slower rate than they did from the other watersheds. Four levels of grazing intensity had no effect on storm runoff. (Author's abstract)
W89-11164

SIMULATION OF THE EFFECTS OF URBANIZATION ON BASIN STREAMFLOW.
Canada Centre for Inland Waters, Burlington (Ontario).
For primary bibliographic entry see Field 4C.
W89-11167

COMPARISON OF METHODS FOR ESTIMATING FLOOD MAGNITUDES ON SMALL STREAMS IN GEORGIA.
Geological Survey, Doraville, GA. Water Resources Div.
G. W. Hess, and M. Price.
Water Resources Bulletin WARBAQ, Vol. 25, No. 1, p 149-154, February 1989. 1 fig, 4 tab, 8 ref.

Descriptors: *Flood data, *Flood frequency, *Rainfall-runoff relationships, *Streams, Comparison studies, *Model studies, Simulation, Georgia, Statistical analysis.

The U.S. Geological Survey has collected flood data for small, natural streams at many sites throughout Georgia during the past 20 years. Flood-frequency relations were developed for these data using four methods: (1) observed (log-Pearson Type III analysis), (2) rainfall-runoff model, (3) regional regression equations, and (4) map-model combination. The results of the last

three methods were compared to the analyses of the observed data in order to quantify the differences in the methods and determine if the differences are statistically significant. Comparison of regression-estimates with observed discharges for sites having 20 years (1966-1985) and 10 years (1976-1985) of record at different sites of annual peak record indicate that the regression-estimates are not significantly different from the observed data. Comparison of rainfall-runoff model simulated estimates with observed discharges for sites having 10 years and 20 years of annual peak record indicated that the model-simulated estimates are significantly and not significantly different, respectively. The biasedness is probably due to a 'loss of variance' in the averaging procedures used within the model and the short length of record as indicated in the 10 and 20 years of record. The comparison of map-model simulated estimates with observed discharges for sites having 20 years of annual-peak runoff indicate that the simulated estimates are not significantly different. Comparison of 'improved' map-model simulated estimates with observed discharges for sites having 20 years of annual-peak runoff data indicate that the simulated estimates are different. The average adjustment factor suggested by Lichty and Liscum to calculate the 'improved' map-model overestimates in Georgia by an average of 20% for three recurrence intervals analyzed. (Author's abstract)
W89-11170

MODELS OF DAM-BREAK FLOW IN R-T SPACE.
University of Strathclyde, Glasgow (Scotland). Dept. of Civil Engineering.
For primary bibliographic entry see Field 8B.
W89-11207

VELOCITY DISTRIBUTION IN OPEN CHANNEL FLOW.
Pittsburgh Univ., PA. Dept. of Civil Engineering.
For primary bibliographic entry see Field 8B.
W89-11208

SUPERCRITICAL FLOW IN CHANNEL JUNCTIONS.
Ecole Polytechnique Federale de Lausanne (Switzerland). Dept. de Genie Civil.
For primary bibliographic entry see Field 8B.
W89-11209

EXPERIMENTS IN SIDE-CHANNEL SPILLWAYS.
Ecole Polytechnique Federale de Lausanne (Switzerland). Dept. de Genie Civil.
For primary bibliographic entry see Field 8B.
W89-11210

HYDRAULIC JUMP IN U-SHAPED CHANNEL.
Ecole Polytechnique Federale de Lausanne (Switzerland). Dept. de Genie Civil.
For primary bibliographic entry see Field 8B.
W89-11213

RANDOM SPATIAL NETWORK MODEL BASED ON ELEMENTARY POSTULATES,
Geological Survey, Lakewood, CO.
M. R. Karlinger, and B. M. Troutman.
Water Resources Research WRERAO, Vol. 25, No. 5, p 793-798, May 1989. 1 fig, 5 tab, 22 ref.

Descriptors: *Model studies, *Networks, *Drainage systems, *Geomorphology, *Drainage patterns, *Topology, *Watersheds, Catchment areas, Surface water, Drainage area.

A model for generating random spatial networks that is based on elementary postulates comparable to those of the random topology model is proposed. In contrast to the random topology model, this model ascribes a unique spatial specification to generated drainage networks, a distinguishing property of some network growth models. The simplicity of the postulates creates an opportunity for potential analytic investigations of the probabilistic structure of the drainage networks, while the spatial specification enables analyses of spatially dependent network properties. In the random topology model all drainage networks, conditioned on magnitude (number of first-order streams), are equally likely, whereas in this model all spanning trees of a grid, conditioned on area and drainage density, are equally likely. As a result, link lengths in the generated networks are not independent, as usually assumed in the random topology model. For a preliminary model evaluation, scale-dependent network characteristics, such as geometric diameter and link length properties, and topologic characteristics, such as bifurcation ratio, are computed for sets of drainage networks generated on square and rectangular grids. Statistics of the bifurcation and length ratios fall within the range of values reported for natural drainage networks, but geometric diameters tend to be relatively longer than those for natural networks. (Author's abstract)
W89-11250

FLUXES OF N2O AT THE SEDIMENT-WATER AND WATER-ATMOSPHERE BOUNDARIES OF A NITROGEN-RICH RIVER.
Massachusetts Inst. of Tech., Cambridge. Ralph M. Parsons Lab. for Water Resources and Hydrodynamics.
For primary bibliographic entry see Field 5B.
W89-11254

FLOOD FREQUENCY ANALYSIS WITH REGIONAL AND HISTORICAL INFORMATION.
Cornell Univ., Ithaca, NY. School of Civil and Environmental Engineering.
M. Jin, and J. R. Stedinger.
Water Resources Research WRERAO, Vol. 25, No. 5, p 925-936, May 1989. 7 fig, 9 tab, 42 ref. NSF Grant CEE-8351819.

Descriptors: *Flood frequency, *Historic floods, *Flood forecasting, *Regional floods, *Hydrologic data collections, Monte Carlo method, Forecasting, Prediction, History, Statistical methods.

Generalized maximum likelihood estimators (GMLE/gMLE) that efficiently employ both at-site historical information and systematic flood records with a regional index flood distribution are developed. Monte Carlo experiments document the performance of these estimators in heterogeneous and homogeneous regions, with different historical record lengths, and with various perception thresholds. When carefully employed with stationary flood records and appropriate and robust statistical procedures, historical information is shown to be valuable at those sites where it is available, as well as in the estimation of the regional index flood distribution. The Monte Carlo experiments illustrated the performance of regional methods including probability-weighted moments (PWM)/mean, GMLE/mean, GMLE*R/mean, and the newly developed GMLE/gMLE. At sites with historical data, the regional PWM/mean, GMLE/mean, and GMLE*R/mean estimators perform poorly in comparison to the GMLE/gMLE approach developed here. Flood studies should benefit from use of both good regional and good historical information. (Friedmann-PTT)
W89-11260

REGIONAL FLOOD QUANTILE ESTIMATION FOR A WEIBULL MODEL.
Colorado State Univ., Fort Collins. Dept. of Statistics.
D. C. Boes, J. Heo, and J. D. Salas.
Water Resources Research WRERAO, Vol. 25, No. 5, p 979-990, May 1989. 15 fig, 1 tab, 8 ref, append. NSF Grant ECE-8612307.

Descriptors: *Flood frequency, *Mathematical studies, *Model testing, *Model studies, *Regional analysis, *Flood forecasting, Probabilistic process, Comparison studies, Estimating equations, Floods, Regional floods, Annual floods, Probability distribution.

Estimation of annual flood quantiles at a given site, based on a regional Weibull model with independence in space and time, is considered. A common shape parameter over sites, motivated by an index flood assumption, was assumed. An exact simple formula for the Cramer-Rao lower bound for the variance of unbiased estimators of the quantile is obtained, and the gain of regional flood frequency analysis over single-site analysis can be quantified via this formula. The estimation techniques of the method of moments, the method of probability-weighted moments, and the method of maximum likelihood are compared. Explicit formulae were not obtainable with any of these estimators, yet all estimators were easily obtained implicitly. All sample probability-weighted moments were linear combinations of ordered observations. The resultant quantile estimators were the same regardless of whether they were based on a sample probability-weighted moment with linear weights giving high weight to large observations or high weight to small observations. A limited simulation study showed that all estimators performed quite well for light tailedness (shape parameter = 2) but maximum likelihood and a particular probability-weighted moment estimator outperformed the others under heavy-tailedness (shape parameter = 1/2). (Friedmann-PTT)
W89-11265

CHANNEL LENGTH-MAGNITUDE FORMULA FOR RANDOM NETWORKS: A SOLUTION TO MOON'S CONJECTURE,
Oregon State Univ., Corvallis. Dept. of Mathematics.
For primary bibliographic entry see Field 2J.
W89-11271

SEASONAL COMPARISON OF LEAF PROCESSING IN A TEXAS STREAM.
Southwest Texas State Univ., San Marcos. Aquatic Station.
For primary bibliographic entry see Field 2H.
W89-11297

BENTHIC BACTERIAL BIOMASS AND PRODUCTION IN A BLACKWATER RIVER.
Georgia Univ., Athens. Inst. of Ecology.
For primary bibliographic entry see Field 2H.
W89-11305

MESOSCALE TEMPORAL VARIATION IN BACTERIAL STANDING CROP, PERCENT ACTIVE CELLS, PRODUCTIVITY AND OUTPUT IN A SALT-MARSH TIDAL RIVER.
Georgia Univ., Sapelo Island. Marine Inst.
For primary bibliographic entry see Field 2H.
W89-11306

CONTINUITY OF MAIN STREAM RIVER BACTERIA DEMONSTRATED BY FACTOR ANALYSIS.
Windsor Univ. (Ontario). Dept. of Biology.
For primary bibliographic entry see Field 5C.
W89-11307

STRUCTURE OF BACTERIAL COMMUNITIES IN A CENTRAL EUROPEAN OPEN GRASSLAND STREAM, THE BREITENBACH,
Max-Planck-Inst. fuer Limnologie, Schlitz (Germany, F.R.). Limnologische Flussstation.
For primary bibliographic entry see Field 2H.
W89-11308

METABOLIC COUPLING BETWEEN HETEROTROPHIC AND METHANOGENIC BACTERIA IN A RUNNING WATER FOOD CHAIN.
Fachhochschule BS-WF, Mikrobiologie und Hygiene, Salzdahlumer Strabbe 46-48, 3340 Wolfenbuttel, Fed. Rep. Germany.
For primary bibliographic entry see Field 2H.
W89-11309

UPTAKE OF NUCLEIC ACID PRECURSORS BY AQUATIC MICROBIAL COMMUNITIES

AND PURE CULTURES OF BACTERIA AND ALGAE.
Max-Planck-Inst. fuer Limnologie zu Ploen (Germany, F.R.). Abt. Mikrobenoekologie.
For primary bibliographic entry see Field 2H.
W89-11310

LEAF MATERIAL PRODUCTION IN NYMPHAEA LOTUS L.: IMPLICATIONS FOR SUSTAINED DETRITUS PRODUCTION.
Natchez-Adams County Vocational School, MS.
For primary bibliographic entry see Field 2H.
W89-11322

LONG TERM STUDIES ON SIMULIUM VITTATUM ZETT. (DIPTERA: SIMULIIDAE) IN THE RIVER LAXA, NORTH ICELAND, WITH PARTICULAR REFERENCE TO DIFFERENT METHODS USED IN ASSESSING POPULATION CHANGES.
Iceland Univ., Reykjavik. Biological Inst.
For primary bibliographic entry see Field 2H.
W89-11332

RECYCLING OF MARINE ELEMENTS TRANSPORTED INTO FRESHWATER SYSTEMS BY ANADROMOUS SALMON.
Juneau Center for Fisheries and Ocean Sciences, AK.
For primary bibliographic entry see Field 2H.
W89-11339

CONTINUOUS GROWTH AND CLUMP MAINTENANCE OF POTAMOGETON CRISPUS L. IN NARUTOH RIVER, JAPAN.
Shimane Univ., Matsue (Japan). Faculty of Science.
For primary bibliographic entry see Field 2H.
W89-11364

LEAD ACCUMULATION AND LOCATION IN THE SHOOTS OF THE AQUATIC LIVERWORT SCAPANIA UNDULATA (L.) DUM. IN STREAM WATER AT GREENSIDE MINE, ENGLAND.
National Inst. for Environmental Studies, Ibaraki (Japan).
For primary bibliographic entry see Field 5B.
W89-11368

STRONG EFFECTS OF FORAGING MINNOWS ON A STREAM BENTHIC INVERTEBRATE COMMUNITY.
State Univ. of New York at Albany. Dept. of Biological Sciences.
For primary bibliographic entry see Field 2H.
W89-11370

DISTRIBUTION OF DEPTH OF OVERLAND FLOW ON DESERT HILLSLOPES AND ITS IMPLICATIONS FOR MODELING SOIL EROSION.
State Univ. of New York at Buffalo. Dept. of Geography.
For primary bibliographic entry see Field 2J.
W89-11381

CONTRIBUTION OF SEASONALLY FLOODED LANDS AND MINOR TRIBUTARIES TO THE PRODUCTION OF COHO SALMON IN CARNATION CREEK, BRITISH COLUMBIA.
Department of Fisheries and Oceans, Nanaimo (British Columbia). Fisheries Research Branch.
For primary bibliographic entry see Field 2H.
W89-11396

NUTRIENT LOAD CARRIED BY THE RIVER PO INTO THE ADRIATIC SEA, 1968-87.
Milan Univ. (Italy). Ist. di Biologia.
For primary bibliographic entry see Field 5B.
W89-11417

MAJOR, MINOR AND TRACE ELEMENT DETERMINATIONS FROM A NIGERIAN AQUATIC SEDIMENT.
Ahmadu Bello Univ., Zaria (Nigeria). Center for Energy Research and Training.
For primary bibliographic entry see Field 2K.
W89-11428

REGIONAL LAKE AND RESERVOIR CANONICAL ENVIRONMENTS.
Environmental Monitoring Systems Lab., Las Vegas, NV.
For primary bibliographic entry see Field 2H.
W89-11429

INFLUENCE OF ARTIFICIAL STREAM BOTTOM SILTATION ON EPHEMEROPTERA IN EMERGENCE TRAPS,
Max-Planck-Inst. fuer Limnologie, Schlitz (Germany, F.R.). Limnologische Flussstation.
For primary bibliographic entry see Field 2H.
W89-11443

LEACHING KINETICS OF FRESH LEAF-LITTER WITH IMPLICATIONS FOR THE CURRENT CONCEPT OF LEAF-PROCESSING IN STREAMS.
Konstanz Univ. (Germany, F.R.). Limnological Inst.
For primary bibliographic entry see Field 2H.
W89-11444

CYCLESTHERIA HISLOPI (BAIRD, 1895) (BRANCHIOPODA: CONCHOSTRACA) IN YEWA RIVER, NIGERIA.
Benin Univ., Benin City (Nigeria). Dept. of Zoology.
For primary bibliographic entry see Field 2H.
W89-11448

PHOSPHORUS-DEPENDENT GROWTH KINETICS OF 11 SPECIES OF FRESHWATER ALGAE.
Minnesota Univ., Minneapolis. Dept. of Ecology and Behavioral Biology.
For primary bibliographic entry see Field 2H.
W89-11518

ZOOPLANKTON ABUNDANCE IN THE LOWER ORINOCO RIVER, VENEZUELA.
Colorado Univ. at Boulder. Center for Limnology.
For primary bibliographic entry see Field 2H.
W89-11521

PATTERNS OF BENTHIC INVERTEBRATE ASSEMBLAGES IN RIVERS OF NORTHWESTERN NORTH AMERICA.
Windsor Univ. (Ontario). Dept. of Biology.
For primary bibliographic entry see Field 2H.
W89-11546

EVALUATION OF THE METABOLISM OF SESTONIC AND EPILITHIC COMMUNITIES IN RUNNING WATERS USING AN IMPROVED CHAMBER TECHNIQUE,
Waterloo Univ. (Ontario). Dept. of Biology.
For primary bibliographic entry see Field 2H.
W89-11547

HABITAT PATCHINESS AND MACROBENTHIC COMMUNITY STRUCTURE IN AN UPLAND STREAM IN TEMPERATE VICTORIA, AUSTRALIA.
Monash Univ., Clayton (Australia). Dept. of Zoology.
For primary bibliographic entry see Field 2H.
W89-11548

MICROBIAL GROWTH AND DETRITUS TRANSFORMATIONS DURING DECOMPOSITION OF LEAF LITTER IN A STREAM.
New York Botanical Garden, Bronx, NY. Inst. of Ecosystem Studies.
For primary bibliographic entry see Field 2H.
W89-11550

ECOLOGICALLY USEFUL CLASSIFICATION OF MEAN AND NEAR-BED FLOWS IN STREAMS AND RIVERS,
Murdoch Univ. (Western Australia). School of Biological and Environmental Sciences.
J. A. Davis, and L. A. Barmuta.
Freshwater Biology FWBLAB, Vol. 21, No. 2, p 271-282, April 1989. 3 fig, 28 ref, 2 append.

Descriptors: *Streamflow, *Stream classification, *River flow, *Flow characteristics, Classification, Flow velocity, Base flow, Froude number, Reynolds number, Ecology, Flow around objects, Hydraulic properties, Bottom sediments, Microenvironment, Hydraulic roughness, Streambeds.

A classification derived from fairly simple field measurements can be used to describe mean motion and near-bed flows in streams and rivers. A classification system is proposed that is ecologically useful because it incorporates the combined effects of velocity, depth and substrate roughness to provide a means of quantifying the flow regimes occurring within the microhabitats of stream benthos. Mean motion is characterized by the Reynolds number and the Froude number. Both are easily calculated, and because they are dimensionless, they provide a means of comparing flows at different sites. Five categories of near-bed flows (i.e. the flow microenvironments of stream benthos) are recognized. Flow may be hydraulically smooth or hydraulically rough and the latter category is subdivided further into chaotic flow, wake interference flow, isolated roughness flow and skimming flow. Hydraulically smooth flows occur in sections of a river bed with fine sediments (e.g. sands, muds and clays), over flat sheets of bedrock, or in association with the flat blades of submerged macrophytes. Hydraulically rough flows occur where the substrate elements are larger (e.g. pebbles, cobbles and boulders) and are a function of substrate roughness and depth of flow relative to the height of the roughness elements. Chaotic flows and wake interference flow predominate in riffles while isolated roughness flows and skimming flows are more likely to be a feature of runs. This classification should enable different flow microenvironments to be recognized and so sample more appropriately which, in turn, may reduce apparent clumping and th wide confidence intervals of benthic population estimates. Because this system identifies 'patches' within the flow regime associated with the stream bed, it enables stream ecologists to generate testable hypotheses regarding the distribution and abundance of benthic species in response to flow. The system identifies spatial patterns in the flow regimes associated with the stream bed. (Author's abstract)
W89-11551

FACTORS INFLUENCING PERIPHYTON GROWTH IN AGRICULTURAL STREAMS OF CENTRAL ILLINOIS.
Illinois Natural History Survey, Champaign. Aquatic Biology Station.
For primary bibliographic entry see Field 2H.
W89-11553

BACTERIOPLANKTONIC BIOMASS AND PRODUCTION IN THE RIVER MEUSE (BELGIUM).
Universite Libre de Bruxelles (Belgium). Groupe de Microbiologie des Milieux Aquatiques.
For primary bibliographic entry see Field 2H.
W89-11554

DIEL DRIFT IN CHIRONOMIDAE LARVAE IN A PRISTINE IDAHO MOUNTAIN STREAM.
Geological Survey, Menlo Park, CA.
For primary bibliographic entry see Field 2H.
W89-11556

RAINFALL VARIATION AND SOME IMPLICATIONS FOR FLOODING IN THE ALLAN CATCHMENT, CENTRAL SCOTLAND.
Southern Water Authority, Worthing (England). East Sussex Water and Drainage Div.
For primary bibliographic entry see Field 2B.
W89-11566

CHANCE-CONSTRAINED MODEL FOR MANAGEMENT OF STREAM-AQUIFER SYSTEM.
California Univ., Davis. Dept. of Land, Air and Water Resources.
For primary bibliographic entry see Field 4B.
W89-11596

EXPERT SYSTEM FOR CALIBRATING SWMM.
Purdue Univ., Lafayette, IN. School of Civil Engineering.
C. Baffaut, and J. W. Delleur.
Journal of Water Resources Planning and Management (ASCE) JWRMD5, Vol. 115, No. 3, p 278-298, May 1989. 2 fig, 2 tab, 19 ref, append. Funding by the U.S. Geological Survey through the Purdue University Water Resources Research Center Project No. G 1224-03.

Descriptors: *Urban hydrology, *Storm runoff, *Model studies, *Expert systems, *Storm water, *Water management, *Computer models, *Calibrations, Automation, Simulation analysis, Water quality.

The U.S. Environmental Protection Agency's Storm Water Management Model (SWMM) simulates all aspects of the hydrologic and quality cycles. Using expert system technology, an interactive user-support framework has been developed to automate the calibration of the runoff block. It acts as a front end to assist the user in the initial estimation of the parameter values and in building the SWMM input files. It interprets the simulation results and suggests some useful adjustments in the value of significant parameters, thus reducing the user's time and effort. For the interpretation of simulation results, production rules are employed to help the user decide what parameters need to be adjusted. Some heuristics have been developed to evaluate the new parameter values. The combination of simulation techniques and expert system methodologies facilitates the use of sophisticated models such as SWMM. (Author's abstract)
W89-11597

LOW-FLOW FREQUENCY ANALYSIS USING PROBABILITY-PLOT CORRELATION COEFFICIENTS.
Tufts Univ., Medford, MA. Dept. of Civil Engineering.
R. M. Vogel, and C. N. Kroll.
Journal of Water Resources Planning and Management (ASCE) JWRMD5, Vol. 115, No. 3, p 338-357, May 1989. 6 fig, 3 tab, 37 ref.

Descriptors: *Probability distribution, *Streamflow forecasting, *Parametric hydrology, *Correlation coefficient, *Low flow, Flow pattern, Statistical analysis, Massachusetts, Graphical analysis.

Although a vast amount of literature exists on the selection of an appropriate probability distribution for annual maximum floodflows, few studies have examined which probability distributions are most suitable to fit to sequences of annual minimum streamflows. Probability plots have been used widely in hydrology as a graphical aid to assess the goodness of fit of alternative distributions. Recently, probability-plot correlation-coefficient (PPCC) tests were introduced to test the normal, two-parameter log-normal and Gumbel hypotheses. Those procedures are extended here to include both regional and at-site tests for the two-parameter Weibull and log-normal distributional hypotheses. In theory, PPCC-hypothesis tests can only be developed for two-parameter distributions that exhibit a fixed shape. Nevertheless, the PPCC is a useful goodness-of-fit statistic for comparing three-parameter log-normal, two-parameter and three-parameter Weibull, and log-Pearson type III distributions to sequences of annual minimum seven-day low flows at 23 sites in Massachusetts are compared. How the PPCC can be used to discriminate among both competing distributional hypotheses for the distributions of fixed shape and competing parameter-estimation procedures for the distributions with variable shape is described. An approximate regional PPCC test is developed and used to show that there is almost no evidence to contradict the hypothesis that annual minimum seven-day low flows in Massachusetts are two-parameter lognormal. (Author's abstract)
W89-11600

EFFECT OF NONPOINT POLLUTANT SOURCES ON WATER QUALITY OF STREAMS IN PUSAN CITY.
For primary bibliographic entry see Field 5C.
W89-11606

DISTRIBUTION AND STATUS OF RARE OR ENVIRONMENTALLY SENSITIVE FISHES IN THE LOWER CAHABA RIVER, ALABAMA.
Alabama Power Co., Birmingham.
For primary bibliographic entry see Field 2H.
W89-11625

LAG-TIME ROUTING OF SUSPENDED SEDIMENT CONCENTRATIONS DURING UNSTEADY FLOW.
Maryland Univ., College Park. Dept. of Geography.
For primary bibliographic entry see Field 2J.
W89-11636

ADSORPTION OF ALUMINIUM BY STREAM PARTICULATES.
Freshwater Biological Association, Ambleside (England).
For primary bibliographic entry see Field 5B.
W89-11646

DISTRIBUTION OF PLANKTONIC BACTERIA CAPABLE OF DEGRADING SODIUM DODECYL SULPHATE (SDS) IN A POLLUTED SOUTH WALES RIVER.
University Coll., Cardiff (Wales). Dept. of Biochemistry.
For primary bibliographic entry see Field 5B.
W89-11647

ESTABLISHING AND MAINTAINING LABORATORY-BASED MICROCOSMS OF RIFFLE INSECT COMMUNITIES: THEIR POTENTIAL FOR MULTISPECIES TOXICITY TESTS.
Virginia Polytechnic Inst. and State Univ., Blacksburg. Center for Environmental and Hazardous Material Studies.
For primary bibliographic entry see Field 5A.
W89-11656

ROUGHNESS AND COLOR OF ARTIFICIAL SUBSTRATUM PARTICLES AS POSSIBLE FACTORS IN COLONIZATION OF STREAM INVERTEBRATES.
Alberta Univ., Edmonton. Dept. of Zoology.
For primary bibliographic entry see Field 2H.
W89-11658

BUFFER EFFECT OF A WIDE RIVERBED SECTION ON SEDIMENT DISCHARGE.
Hokkaido Univ., Sapporo (Japan). Dept. of Forestry.
For primary bibliographic entry see Field 2J.
W89-11661

EFFECT OF SNOWMELT ON THE HYDROGEN ISOTOPE RATIOS OF CREEK DISCHARGE IN SURPRISE VALLEY, CALIFORNIA.
California Univ., Davis. Dept. of Geology.
For primary bibliographic entry see Field 2C.
W89-11677

RIVER DISCHARGE ESTIMATED FROM CHANNEL DIMENSIONS.
Southampton Univ. (England). Dept. of Geography.
G. Wharton, N. W. Arnell, K. J. Gregory, and A. M. Gurnell.
Journal of Hydrology JHYDA7, Vol. 106, No. 3/4, p 365-376, April 20 1989. 2 fig, 3 tab, 27 ref.

Descriptors: *Flood discharge, *Channel morphology, *Stream discharge, *Flood forecasting, Overflow channels, Catchment areas, Hydrologic properties, Flood stages, Flood peak, Estimating, Hydraulic properties.

Estimates of flood discharges are often required at ungauged sites. A considerable amount of research has been devoted to the production of reliable flood estimates for ungauged catchments but such estimates are costly to obtain. Although a catchment-based approach has often been used, for example in the U.K. Flood Studies Report, an alternative method is to estimate flows at ungauged sites from river channel dimensions. Data for 72 rivers throughout the U.K. are employed to establish regression relations between measures of peak discharge (Q sub 5, mean annual flood, and Q sub 1.5, where Q sub 5 and Q sub 1.5 are the floods with return periods of 5 and 1.5 years respectively) and channel dimensions (cross sectional area, width and depth at bankfull stage). Channel measurements of area, width and depth individually account for up to 85 percent of the variation of the three discharge variables and the explanation is greatly superior to that obtained by using the more frequently used drainage basin area variable for the same data set. Relationships between discharge and channel dimensions give a rapid means of flow estimation from channel dimensions and can be used effectively prior to hydrological or hydraulic methods. (Author's abstract)
W89-11684

COMPENSATION FLOWS IN THE UK: A HYDROLOGICAL REVIEW.
Institute of Hydrology, Wallingford (England).
For primary bibliographic entry see Field 4A.
W89-11697

MEASURING DISCONTINUITIES IN THE TER RIVER.
Barcelona Univ. (Spain). Dept. de Ecologia.
For primary bibliographic entry see Field 2H.
W89-11703

BIOTIC AND ABIOTIC GRADIENTS IN A REGULATED HIGH ELEVATION ROCKY MOUNTAIN RIVER.
Colorado State Univ., Fort Collins. Dept. of Biology.
For primary bibliographic entry see Field 6G.
W89-11704

EFFECTS OF AN UPLAND IMPOUNDMENT ON STRUCTURAL AND FUNCTIONAL PROPERTIES OF A SMALL STREAM IN A BASALTIC PLATEAU (GOLAN HEIGHTS, ISRAEL).
Tel-Aviv Univ. (Israel). Inst. for Nature Preservation Research.
For primary bibliographic entry see Field 6G.
W89-11705

SERIAL DISCONTINUITIES IN A ROCKY MOUNTAIN RIVER. I. DISTRIBUTION AND ABUNDANCE OF PLECOPTERA.
Montana Univ., Polson. Flathead Lake Biological Station.
For primary bibliographic entry see Field 6G.
W89-11706

SERIAL DISCONTINUITIES IN A ROCKY MOUNTAIN RIVER. II. DISTRIBUTION AND ABUNDANCE OF TRICHOPTERA.
Montana Univ., Polson. Flathead Lake Biological Station.
For primary bibliographic entry see Field 6G.

W89-11707

REVIEW OF THE EFFECT OF RIVER REGULATION ON MAYFLIES (EPHEMEROPTERA),
Oslo Univ. (Norway). Lab. for Freshwater Ecology and Inland Fisheries.
For primary bibliographic entry see Field 6G.
W89-11709

STUDY OF PHYSICAL PARAMETERS AT THE SPAWNING SITES OF THE EUROPEAN GRAYLING (THYMALLUS THYMALLUS L.),
Fiskeristyrelsen, Haernoesand (Sweden). Regional Office.
For primary bibliographic entry see Field 2H.
W89-11711

REMOVAL OF BROWN TROUT (SALMO TRUTTA L.): CHANGES IN POPULATION DYNAMICS IN A WEIR BASIN IN WESTERN NORWAY.
Bergen Univ. (Norway). Zoological Museum.
For primary bibliographic entry see Field 8I.
W89-11712

EFFECTS OF STREAM REGULATION ON ATLANTIC SALMON, SALMO SALAR L., AND BROWN TROUT, SALMO TRUTTA L., IN THE UPPER SEVERN CATCHMENT, U.K.
Humberside Coll. of Higher Education, Grimsby (England).
For primary bibliographic entry see Field 6G.
W89-11713

EXPLOITATION RATE, SURVIVAL AND MOVEMENTS OF BROWN TROUT (SALMO TRUTTA L.) STOCKED AT TAKEABLE SIZE IN THE REGULATED RIVERS LAGEN AND OTTA, SOUTHERN NORWAY.
Environmental Division, Statsetatenes hus, N-2600 Lillehammer, Norway.
For primary bibliographic entry see Field 2H.
W89-11714

DEVELOPMENT OF HABITAT SUITABILITY CRITERIA FOR TROUT IN SMALL STREAMS.
Pacific Gas and Electric Co., San Ramon, CA.
For primary bibliographic entry see Field 2H.
W89-11718

ANALYSIS OF BROWN TROUT (SALMO TRUTTA FARIO L.) HABITAT: THE ROLE OF QUALITATIVE DATA FROM EXPERT ADVICE IN FORMULATING PROBABILITY-OF-USE CURVES,
Aix-Marseille-1 Univ. (France). Lab. d'Hydrobiologie.
For primary bibliographic entry see Field 2H.
W89-11719

PROBABILITY-OF-USE CURVES APPLIED TO BROWN TROUT (SALMO TRUTTA FARIO L.) IN RIVERS OF SOUTHERN FRANCE.
Ecole Nationale Superieure Agronomique de Toulouse (France).
For primary bibliographic entry see Field 2H.
W89-11720

DETERMINATION OF HYDRAULIC PARAMETERS FOR INSTREAM FLOW ASSESSMENTS.
Electricite de France, Paris. Direction des Etudes et Recherches.
A. Courot.
Regulated Rivers Research and Management RRRMEP, Vol. 3, No. 1-4, p 337-344, Jan-Apr 1989. 2 fig, 4 tab, 6 ref.

Descriptors: *Hydraulic properties, *Instream flow, *France, Instream Flow Incremental Model, Model studies, Water depth, Velocity, Habitat, Streamflow, Trout.

Determination of the hydraulic parameters of a stream is the first stage in the instream flow incremental method (IFIM). Two different modelings have been applied to simulate the hydraulic conditions (i.e. depth and velocity) of the Orne river at Rabodanges in order to assess the changes in fish habitat with the flow. One process consists of representing the reach examined by a few sections (the pilot sections), the other is a conventional flow model. The accuracy of both types of model has been calculated by comparison with depth and velocity data available for four different rates of flow. For the flow model, the accuracy of depth calculations is average (16 per cent) but decreases for low rates of flow. Velocity values are less accurate (24 per cent). For the pilot sections method, the degree of accuracy for velocity values are not as accurate (80 per cent), but the depth values are accurate (7 per cent). In both methods, the degree of accuracy of the percent usable area depends on the accuracy of the hydraulic variables. For brown trout juveniles and fry the accuracy on per cent usable area is of the same order of magnitude as the degree of accuracy of depth. The inaccuracy on velocities due to the method is not totally reflected in the per cent usable area values. The probability-of-use curves of the species considered can act as a filter for errors linked to the method followed for assessing hydraulic parameters. (Author's abstract)
W89-11721

ORINOCO RIVER: A REVIEW OF HYDROBIOLOGICAL RESEARCH,
Fundacion La Salle de Ciencias Naturales, San Felix (Venezuela).
E. Vasquez.
Regulated Rivers Research and Management RRRMEP, Vol. 3, No. 1-4, p 381-392, Jan-Apr 1989. 4 fig, 65 ref.

Descriptors: *Orinoco River, *Hydrobiology, *Reviews, *Venezuela, *Colombia, *River basin development, Regulated rivers, Zooplankton, Phytoplankton, Aquatic plants, Fisheries, Dams, Industrial development, Multiobjective planning.

Development programs on the Orinoco River include mining, oil exploration and extraction, industry, river transport, and hydroelectric exploitation. Development of hydroelectric power has involved the construction of two dams on the Caroni River (a backwater tributary) and two more are planned. Hydroelectric projects are also being considered for the Orinoco River. Systematic hydrobiological research has recently been carried out in the river, some of its major tributaries, and floodplain lakes, and a fair amount of knowledge has emerged mainly from its lower section. Phytoplankton studies have revealed the presence of over 400 species of algae. Zooplankton research has identified 116 taxa of rotifers and 58 taxa of cladocerans. In general plankton densities negatively correlate with water level. Diatoms were observed to predominate in the Orinoco River while Cyanophyta predominate in the studied floodplain lakes. Seventeen aquatic macrophyte species have been recorded in the lakes of the Orinoco, and rooted emergent and floating-plant cover tends to increase rapidly during high water. Some 318 species and subspecies of fish have been reported for the Orinoco Basin, even though this number is far from complete. Preliminary data have revealed different species associations among relatively close lakes with biomasses ranging between 30 to 900 kg/ha displaying considerable variations in diversity and species richness. Fisheries along the Orinoco are mainly of a multispecific nature and their overall potential has been estimated as being in the order of 45,000 t/yr. In general, management plans have taken into consideration the multispecific potential of the Orinoco Basin but indicate a lack of sufficient knowledge of the physical, biological, and social aspects involved. (Author's abstract)
W89-11726

ASSESSMENT OF BED LOAD SEDIMENT TRANSPORT FORMULAE FOR GRAVEL BED RIVERS,
Oxford Univ. (England). Geography School.
For primary bibliographic entry see Field 2J.
W89-11759

PHYSICALLY BASED MODEL OF HETEROGENEOUS HILLSLOPES: 1. RUNOFF PRODUCTION,
Lancaster Univ. (England). Centre for Research on Environmental Systems.
For primary bibliographic entry see Field 2A.
W89-11763

PHYSICALLY BASED MODEL OF HETEROGENEOUS HILLSLOPES: 2. EFFECTIVE HYDRAULIC CONDUCTIVITIES,
Lancaster Univ. (England). Centre for Research on Environmental Systems.
For primary bibliographic entry see Field 2A.
W89-11764

SEDIMENT TRANSPORT AND RESULTING DEPOSITION IN SPAWNING GRAVELS, NORTH COASTAL CALIFORNIA.
Pacific Southwest Forest and Range Experiment Station, Arcata, CA.
For primary bibliographic entry see Field 2J.
W89-11771

TREE RING ANALYSIS OF SURPLUS AND DEFICIT RUNOFF IN THE WHITE RIVER, ARKANSAS.
Arkansas Univ., Fayetteville. Dept. of Geography.
M. K. Cleaveland, and D. W. Stahle.
Water Resources Research WRERAO, Vol. 25, No. 6, p 1391-1401, June 1989. 6 fig, 4 tab, 49 ref. USGS State Water Research Institute Program Grant G-1409-02 and NSF Grants ATM-8006964, ATM-8120615, ATM-8412912, and ATM-8612343.

Descriptors: *Paleoclimatology, *Runoff, *Arkansas, *Dendrochronology, *Rainfall-runoff relationships, Drought, Floods, White River, Oklahoma, Missouri, Statistics, Hydrologic data collections, Probability, Prediction, Nonrandom distribution.

A 281-yr reconstruction of White River calendar year runoff at Clarendon, Arkansas, was developed from regional average of nine tree ring chronologies in Oklahoma, Missouri, and Arkansas (including six post oak and three bald cypress chronologies). Inhomogeneity of the gaged runoff series prior to 1930 was detected with two independent double mass analyses, comparing the gaged data with Arkansas state average annual precipitation and the regional tree ring chronology average. The homogeneous runoff data from 1930 to 1980 were calibrated with the average tree ring data using regression. The variance of the reconstruction increases significantly during the twentieth century and may reflect climatic change and/or anthropogenic disturbances in the watershed. Years of surplus and deficit runoff are nonrandomly distributed in both the gaged and reconstructed series. This nonrandomness appears to be caused primarily by interannual persistence of runoff extremes, which may provide a basis for some improvement of probabilistic forecasts of annual runoff for the White River. (Author's abstract)
W89-11778

LONGITUDINAL DISPERSION IN RIVERS: A DEAD-ZONE MODEL SOLUTION.
Kansas Univ., Lawrence. Dept. of Civil Engineering.
For primary bibliographic entry see Field 5B.
W89-11793

COMPARISON OF METHODS OF ESTIMATING MEAN WATERSHED SLOPE,
Stephen F. Austin State Univ., Nacogdoches, TX. School of Forestry.
M. Chang, S. P. Watters, and A. K. Sayok.
Water Resources Bulletin WARBAQ, Vol. 25, No. 2, p 327-333, April 1989. 1 fig, 4 tab, 24 ref.

Descriptors: *Geomorphology, *Watersheds, *Slopes, *Topography, Mathematical studies, Texas, Forest watersheds.

Ten topographic analysis methods were employed to estimate watershed mean slopes for 13 small

forested watersheds (32 to 131 sq mi) in East Texas. Of the ten methods employed, the mean slope curve is the most accurate but also the most tedious and laborious. The method can be simplified by measuring only the lengths of five contours and the areas between these contours within the watershed with little loss of its accuracy. Watershed slopes estimated by the contour length method are satisfactory for general purposes and relatively simple. The watershed circumference-stream length method, the length-width axis method, the Justin method, and the regression plane method are not suitable for estimating watershed slopes in East Texas without modification. (Author's abstract)
W89-11794

STANDARDIZATION OF PEAK-VOLUME TRANSFORMATIONS.
Arizona Univ., Tucson. School of Renewable Natural Resources.
R. H. Hawkins, and R. A. Pole.
Water Resources Bulletin WARBAQ, Vol. 25, No. 2, p 377-380, April 1989. 2 fig, 1 tab, 7 ref.

Descriptors: *Flood peak, *Standards, *Flood peak, *Mathematical studies, Runoff, Flow velocity.

A general treatment of logarithmic transformations and standardization of peak flows on powers of direct runoff is given. Two examples of the effects of this relationship are illustrated: for the Little Papillon Creek and for the Niobrara River. The interpretation shows that there is no basis in reason and no justification in practice for the power standardization. All power standardization may be calculated from the original relationship. (Lantz-PTT)
W89-11800

REAL-TIME QUALITY CONTROL OF STREAMFLOW DATA--A SIMULATION STUDY.
Iowa Inst. of Hydraulic Research, Iowa City.
For primary bibliographic entry see Field 7B.
W89-11802

MERITS OF STATISTICAL CRITERIA FOR THE PERFORMANCE OF HYDROLOGICAL MODELS.
Eidgenoessisches Inst. fuer Schnee- und Lawinenforschung, Davos (Switzerland).
For primary bibliographic entry see Field 7C.
W89-11805

PHYSICAL HABITAT USE BY LOACH MINNOW, TIAROGA COBITIS (PISCES: CYPRINIDAE), IN SOUTHWESTERN DESERT STREAMS.
Rocky Mountain Forest and Range Experiment Station, Tempe, AZ. Forestry Sciences Lab.
For primary bibliographic entry see Field 6G.
W89-11810

WEST BRANCH SUSQUEHANNA RIVER SUBBASIN; LOW FLOW MANAGEMENT FRAMEWORK PLAN.
Susquehanna River Basin Commission, Harrisburg, PA.
For primary bibliographic entry see Field 6D.
W89-12103

PRELIMINARY ANALYSIS OF NUTRIENT MONITORING DATA FOR THE SUSQUEHANNA RIVER AND SELECTED TRIBUTARIES: JANUARY 1, 1985-DECEMBER 31, 1987.
Susquehanna River Basin Commission, Harrisburg, PA.
A. N. Ott, C. S. Takita, R. E. Edwards, and S. W. Bollinger.
Susquehanna River Basin Commission Publication No. 120, April 1988. 21p, 2 fig, 4 tab, append.

Descriptors: *Water quality, *Nutrients, *Susquehanna River, Pollution load, Fate of pollutants, Data collections, Monitoring, Phosphorus, Suspended sediments, Nitrates, Nitrites, Ammonia, Organic carbon.

The joint Susquehanna River Basin Commission (SRBC)/Pennsylvania Department of Environmental Resources (PaDER), Bureau of Soil and Water Conservation and Bureau of Laboratories/ U.S. Geological Survey (USGS) program was conducted to collect, collate, analyze and disseminate nutrient data for the Susquehanna River and selected tributaries. The program established a sound data base which can be used to effectively plan and implement both immediate and long-range nutrient reduction efforts and support modeling activities. Sample collection began at twelve sites in the Susquehanna River basin in October, 1984. Yearly sampling consists of collecting twelve monthly baseflow samples as well as storm samples during each of the four seasons. Storm coverage includes sample collection on both the rising and falling stream stage. Chemical constituents analyzed include: nitrite+nitrate-N, total; ammonia-N, total; Kjeldahl N, total and dissolved; Phosphorus, total and dissolved; Orthophosphate-P, dissolved; Organic carbon, total; and concentrations of suspended sediment are determined for all samples at the USGS sediment laboratory. The annual nutrient loads for CY-1986 in the Susquehanna River Basin are: organic nitrogen-28,548 tons; inorganic nitrogen-55,740 tons; total nitrogen-84,827 tons; total phosphorus-4,598 tons; suspended sediment-3,626,683 tons; dissolved phosphorus-1,711 tons; total nitrite plus nitrate nitrogen-52,825 tons; total ammonia as nitrogen-2,915 tons; dissolved Kjeldahl nitrogen-20,298 tons; total Kjeldahl nitrogen-33,210 tons; and total organic carbon-162,800 tons. (Lantz-PTT)
W89-12104

FLUSHING AND SCOURING FLOWS FOR HABITAT MAINTENANCE IN REGULATED STREAMS.
Environmental Protection Agency, Washington, DC. Office of Water Regulations and Standards.
For primary bibliographic entry see Field 4A.
W89-12109

FLOOD CHARACTERISTICS OF BRINDABELLA CATCHMENTS, AUSTRALIAN CAPITAL TERRITORY.
Commonwealth Scientific and Industrial Research Organization, Canberra (Australia). Div. of Water and Land Resources.
R. Srikanthan, and J. Burns.
Commonwealth Scientific and Industrial Research Organization Technical Memorandum 88/14, November 1988. 83p, 27 ref, 3 append.

Descriptors: *Australia, *Experimental basins, *Floods, *Peak discharge, *Flood peak, Statistical analysis, Catchment areas, Distribution analysis, Data interpretation, Annual floods.

Peak discharge data from 15 experimental catchments in the Cotter Valley, ACT, were analyzed. Both the instantaneous and hourly mean values were used to form annual maximum series. Several distributions were fitted to the annual maximum series and their goodness of fit evaluated. Transformed normal distribution provided the best fit followed closely by log Pearson type III distribution. Estimates of mean annual flood obtained from partial duration series did not agree with those obtained from annual maximum series. Compound Poisson-Exponential distribution produced satisfactory estimates of annual floods when the number of items in the partial duration series is equal to the length of the record in years. The use of log Pearson type III distribution with partial duration series requires the number of floods in partial duration series to be equal to the number of years of the record. (Author's abstract)
W89-12135

2F. Groundwater

MICROBIAL TRANSFORMATIONS OF AZAARENES IN CREOSOTE-CONTAMINATED SOIL AND GROUND WATER: LABORATORY AND FIELD STUDIES.
Geological Survey, Denver, CO.
For primary bibliographic entry see Field 5B.
W89-11072

DETERMINATION OF ACTIVE BIOMASS.
Technical Univ. of Denmark, Lyngby. Dept. of Sanitary Engineering.
For primary bibliographic entry see Field 5D.
W89-11099

BIOLOGICAL ELIMINATION OF DICHLOROMETHANE FROM CONTAMINATED GROUNDWATER-INTERFERENCE BY COMPONENTS OF THE GROUNDWATER.
Stuttgart Univ. (Germany, F.R.). Inst. fuer Siedlungswasserbau, Wassergutewirtschaft und Abfalltechnik.
For primary bibliographic entry see Field 5G.
W89-11123

APPLYING BACTERIOLOGICAL PARAMETERS FOR EVALUATING UNDERGROUND WATER QUALITY.
National Research Centre, Cairo (Egypt). Water Pollution Control Lab.
For primary bibliographic entry see Field 5A.
W89-11128

BACTERIAL BIODEGRADATION OF PETROLEUM HYDROCARBONS IN GROUNDWATER: IN SITU AUGMENTED BIORECLAMATION WITH ENRICHMENT ISOLATES IN CALIFORNIA.
CytoCulture International, Inc., San Francisco, CA.
For primary bibliographic entry see Field 5G.
W89-11147

MODELING MICROBIAL TRANSPORT IN POROUS MEDIA.
Montana State Univ., Bozeman. Inst. for Biological and Chemical Process Analysis.
For primary bibliographic entry see Field 5B.
W89-11149

MEASURING DROUGHT IMPACTS: THE ILLINOIS CASE.
Illinois State Water Survey Div., Champaign. Climatology and Meteorology Section.
For primary bibliographic entry see Field 2E.
W89-11158

WATERSHED MODELS AND THEIR APPLICABILITY TO CONJUNCTIVE USE MANAGEMENT.
Butler Univ., Indianapolis, IN. Holcomb Research Inst.
A. I. El-Kadi.
Water Resources Bulletin WARBAQ, Vol. 25, No. 1, p 125-137, February 1989. 1 fig, 2 tab, 83 ref. EPA Cooperative Agreement No. CR-812603.

Descriptors: *Watershed management, *Conjunctive use, *Water resources management, *Groundwater management, *Infiltration, *Groundwater movement, *Model studies.

Techniques employed to simulate infiltration and subsurface groundwater flow were examined for a number of available watershed models. The large number of processes that these models simulate prohibits detailed analysis of subsurface flow, due to excessive computer and data requirements. Such models emphasize surface flow and include only that portion of water lost to the subsurface and the portion returned to the stream as baseflow. Problems were examined in adopting conjunctive use models, which allow the coordinated exploitation and management of both surface and groundwater resources. The application of conjunctive use models in water resources management is expected to increase dramatically over the next decade. (Author's abstract)
W89-11168

BIOGEOCHEMISTRY OF MARIANA ISLANDS COASTAL SEDIMENTS: TERRESTRIAL INFLUENCE ON DELTA-C13, ASH, CACO3, AL, FE, SI AND P.
Guam Univ., Agana. Marine Lab.
For primary bibliographic entry see Field 2J.
W89-11206

CONTAMINANT TRANSPORT IN A SINGLE FRACTURE: PERIODIC BOUNDARY AND FLOW CONDITIONS.
Georgia Inst. of Tech., Atlanta. School of Geophysical Sciences.
For primary bibliographic entry see Field 5B.
W89-11248

ASSESSING THE VALIDITY OF THE CHANNEL MODEL OF FRACTURE APERTURE UNDER FIELD CONDITIONS.
Geological Survey, Reston, VA.
A. M. Shapiro, and J. R. Nicholas.
Water Resources Research WRERAO, Vol. 25, No. 5, p 817-828, May 1989. 9 fig, 3 tab, 4 ref.

Descriptors: *Groundwater movement, *Model studies, *Tracers, *Geologic fractures, *Hydraulic properties, *Channel flow, *Geohydrology, Flow channels, Fluid flow, Distribution graphs, Closed-conduit flow, Performance evaluation.

In recent investigations of fluid and solute movement in discrete fractures, spatial heterogeneity of the fracture aperture has been conceptualized as a series of noninterconnecting constant aperture flow paths, or channels. Two methods of estimating the distribution of the aperture sizes are presented using information from a single-hole pumping test and a radially converging tracer test. The first method uses the transmissivity of the fracture and mean arrival time of the tracer, while the second method uses the mean and variance of the solute arrival time. If the fracture can be conceptualized as a series of nonintersecting flow paths of constant aperture, the two methods should yield identical estimates for the parameters of the distribution. The validity of the channel model can be assessed by comparing the parameters of the distribution that are estimated by the two methods. This technique was demonstrated using hydraulic and tracer tests conducted in a discrete, areally extensive, horizontal fracture in the Silurian dolomite in northeastern Illinois. A lognormal and a truncated gamma distribution were used to describe the distribution of constant aperture flow paths. The lognormal distribution could not reproduce the abrupt rising limb and maximum rate of mass arrival that characterized the tracer tests. The gamma distribution more accurately predicted the shape of the breakthrough curves; however, the two methods of estimating the parameters of the distribution provided significantly different estimates of the variances of the aperture sizes. The mean aperture as estimated by the two methods was similar. The difference in the variance of the aperture as estimated by the two methods indicates that alternative conceptual models of aperture heterogeneity are required to more accurately describe both fluid and solute movement in this field situation. (Author's abstract)
W89-11252

BOUNDARY CONDITIONS AND POINT SOURCES IN THE FINITE ELEMENT INTEGRATION OF THE TRANSPORT EQUATION,
Centro di Ricerca Idraulica e Strutturale, Milan (Italy).
G. Galeati, and G. Gambolati.
Water Resources Research WRERAO, Vol. 25, No. 5, p 847-856, May 1989. 14 fig, 18 ref.

Descriptors: *Boundary conditions, *Groundwater movement, *Finite element method, *Geohydrology, *Hydrologic properties, *Diffusivity, Convection, Mathematical equations, Injection wells, Pump wells, Groundwater pollution, Darcys law.

In the finite element integration of the convection-dispersion equation over a groundwater domain, boundary conditions of the third (or Cauchy) type may or may not be incorporated with the variational statement. While the former development (formulation A) requires the application of Green's First identity to both the convective and the dispersive terms, the latter (formulation B) does not. Although both approaches are equivalent at the theoretical level, they behave differently from a computational standpoint. The numerical solution proves more accurate and stable if Green's lemma is not applied to the convective term, since significant errors arising from the representation of the Darcy velocity over the elements are avoided. Point sources or sinks representing injection or pumping wells can be treated as either sources (sinks) distributed over a small volume or external boundaries with prescribed contaminant flux. It is shown that when the well bore is excluded from the flow field, formulation a yields the same matrix addition for an injection well as formulation B does for an abstraction well (reciprocity of the results). (Author's abstract)
W89-11255

DISCRETE KERNEL METHOD OF CHARACTERISTICS MODEL OF SOLUTE TRANSPORT IN WATER TABLE AQUIFERS,
Colorado Univ. at Boulder. Dept. of Civil, Environmental, and Architectural Engineering.
For primary bibliographic entry see Field 5B.
W89-11256

SIMPLE ANALYTIC FUNCTIONS FOR MODELING THREE-DIMENSIONAL FLOW IN LAYERED AQUIFERS.
GeoTrans, Inc., Harvard, MA.
C. R. Fitts.
Water Resources Research WRERAO, Vol. 25, No. 5, p 943-948, May 1989. 9 fig, 2 tab, 14 ref.

Descriptors: *Stratified flow, *Groundwater movement, *Hydrologic models, *Aquifers, *Geohydrology, *Hydraulic conductivity, Leaky aquifers, Boundary conditions, Hydrologic properties, Flow discharge, Groundwater, Model studies, Impervious boundaries, Mathematical analysis.

Analytic functions are presented for modeling three-dimensional steady groundwater flow in stratified aquifers. The functions create discontinuity in the potential across an infinite plane while maintaining continuity of the potential gradient across the plane. These functions may be superimposed with other analytic functions to model three-dimensional flow in stratified aquifers under a variety of boundary conditions. An interface between two layers of different hydraulic conductivity, an impermeable boundary, or a thin leaky layer may be modeled using such functions. These functions are simple compared to functions for doublet distributions over finite panels and are suitable for efficient modeling. Examples of the functions show that the approximation of boundary conditions on the planar discontinuities can be very good and can be made acceptable for more diverse applications by specifying more degrees of freedom and more control points. An important boundary condition, continuity of flow, is guaranteed on the entire surface of each planar discontinuity. Other analytic functions can be superimposed with the presented functions; line/sinks or point/sinks can be used to represent discharge to wells, streams, or from infiltration trenches. (Friedmann-PTT)
W89-11262

EVALUATION OF GROUNDWATER REPLENISHMENT COEFFICIENTS FROM THE RECORD OF A BOREHOLE PENETRATING THE UNSATURATED ZONE.
Ministry of Agriculture, Jerusalem (Israel). Hydrological Service.
Y. Bachmat, H. Gvirtzman, and M. Magaritz.
Water Resources Research WRERAO, Vol. 25, No. 5, p 973-978, May 1989. 3 fig, 4 tab, 9 ref.

Descriptors: *Observation wells, *Infiltration, *Recharge, *Groundwater recharge, *Water yield, *Surface-groundwater relations, *Aeration zone, *Data interpretation, Mathematical studies, Prediction, Israel, Boreholes, Aquifer characteristics, Coastal plains, Deserts, Correlation coefficient.

The coefficients of groundwater replenishment from surficial sources are the most critical parameters in assessing the exploitable yield of an aquifer. So far, the methods used for estimating these coefficients failed to yield plausible results, either because of crude models of the system or because of a simultaneous estimation of many parameters requiring long and diverse data records. A method is proposed for obtaining the in situ chronological sequence of the coefficients of replenishment at a given site, independently from the estimates of other parameters. It is based on the profiles of water content and concentrations of tritium and chloride in a single borehole penetrating the unsaturated zone. A combination of these data with the historical record of their inputs at the surface of the ground enables dating of the moisture content in each depth interval. This yields a series of seasonal replenishment coefficients from both natural and anthropogenic sources. The proposed method was applied in interpreting field data records obtained at two sites, a small diameter borehole drilled through the unsaturated zone in the Coastal Plain of Israel and an excavation penetrating the unsaturated zone at the Omer site in the Northern Negev. Results of these applications showed that a predictor of replenishment with no constant is preferable to that with a constant. The predictor with no constant, in all cases, has a correlation coefficient close to 1, while the predictor with a constant was less than 0.5 (Friedmann-PTT)
W89-11264

SPATIAL AND TEMPORAL GRADIENTS IN AQUIFER OXIDATION-REDUCTION CONDITIONS.
Illinois State Water Survey Div., Champaign.
For primary bibliographic entry see Field 2K.
W89-11266

OPTIMUM EXPERIMENTAL DESIGN FOR PARAMETER IDENTIFICATION IN GROUNDWATER HYDROLOGY.
California Univ., Los Angeles. Dept. of Civil Engineering.
H. Nien-Sheng, and W. W. Yeh.
Water Resources Research WRERAO, Vol. 25, No. 5, p 1025-1040, May 1989. 6 fig, 15 tab, 35 ref. NSF grants CEE 81-13500 and CEE 83-01230.

Descriptors: *Network design, *Confined aquifers, *Geohydrology, *Experimental design, *Hydrologic models, *Aquifer systems, *Groundwater movement, Mathematical studies, Pump wells, Observation wells, Simulation, Optimization, Parameterization, Computer programs.

The experimental design for parameter identification of a confined groundwater system is formulated as a nonlinear mixed integer programming problem. The decision variables considered are the number and locations of the pumping and observation wells, and the pumping rates. The constraints include the allowable drawdown, the restricted locations of pumping wells and observation wells, the permissible pumping rates, and the required information. The amount of the required information is determined by the prescribed reliability of the response for the future operation of the groundwater system. The Galerkin finite element-Crank Nicolson approach is used to develop the simulation models for solving the groundwater governing equation for the system responses. The sensitivity coefficients are computed by the influence coefficient method. The principle of superposition is used to combine the simulation models with the optimization model. The characteristics of the optimization problem have been investigated and are clarified, and its difficulties pointed out. An efficient heuristic solution approach is proposed for solving this problem. A test problem is constructed to demonstrate the usefulness of the proposed methodology. Observations generated from the optimal design are used to identify parameters. A covariance analysis is then carried out to verify the validity of the assumptions made in the formulation of the optimization problem. The results obtained indicate that the proposed methodology is feasible and can be used to solve complicat-

ed experimental design problems associated with a confined groundwater system. (Author's abstract)
W89-11269

HYDRODYNAMIC DISPERSION AT THE LOCAL SCALE OF CONTINUUM REPRESENTATION.
Atomic Energy of Canada Ltd., Chalk River (Ontario). Chalk River Nuclear Labs.
For primary bibliographic entry see Field 5B.
W89-11270

BOUWER AND RICE SLUG TEST-AN UPDATE,
Agricultural Research Service, Phoenix, AZ. Water Conservation Lab.
For primary bibliographic entry see Field 7B.
W89-11272

COASTAL GROUND-WATER BOUNDARY,
Rhode Island Univ., Kingston. Dept. of Civil and Environmental Engineering.
D. W. Urish, and M. M. Ozbilgin.
Ground Water GRWAAR, Vol. 27, No. 3, p 310-315, May-June 1989. 7 fig, 1 tab, 13 ref. NSF Grant Eng-7908084.

Descriptors: *Saline water intrusion, *Geohydrologic boundaries, *Surface-groundwater relations, *Coastal waters, *Saline-freshwater interfaces, *Groundwater movement, Piezometers, Water level, Sea level.

In many island and coastal groundwater problems, the position of the groundwater/free seawater interface is an essential, but highly dynamic boundary. The fluctuating boundary commonly is simplified to a fixed position in problem formulation. This fixed position is frequently taken as the location of local mean free-water level (mean sea level) in the adjacent salt water body. However, tidal fluctuation and wave runup on a sloping beach cause mounding of sea water in the upper beach with a consequent effective mean sea level as much as two feet higher than local mean sea level. This phenomenon is particularly important in small islands and coastal situations where the groundwater flow pattern is highly dependent on the position of the effective boundary both vertically and horizontally. In coastal hydrological situations, a good approximation for the effective vertical position, i.e., effective mean sea level, of the groundwater/free seawater boundary is the mean equivalent salt water head in a deep discretely screened piezometer located in the beach near the upper swash line. When a piezometer was placed in some New England upper beaches to test the application of this method, a good example of the importance of the effective mean sea level boundary as a characteristic of the freshwater lens was demonstrated. At East Beach, it was found that though the mean stillwater level in the ocean was about 0.5 ft (0.2 m) below the mean stillwater level of the lagoon, the effective mean sea level boundary at the ocean was about 1.5 ft (0.5 m) higher than at the lagoon. Determination of the boundary is important in the prediction of flow from pollution sources such as sewage lagoons and waste disposal sites. (Friedmann-PTT)
W89-11273

HYDROLOGIC RESPONSES TO DEVELOPMENT IN REGIONAL SEDIMENTARY AQUIFERS,
Geological Survey, St. Simons Island, GA.
For primary bibliographic entry see Field 4C.
W89-11274

STORAGE BASIN VOLUME AND DRAINAGE BASIN DYNAMICS: CAMAS PRAIRIE, SOUTH-CENTRAL IDAHO.
Northern Arizona Univ., Flagstaff. Dept. of Geology.
B. L. Cluer.
Ground Water GRWAAR, Vol. 27, No. 3, p 323-332, May-June 1989. 8 fig, 5 tab, 21 ref.

Descriptors: *Geohydrology, *Geophysics, *Gravity studies, *Groundwater storage, *Aquifers, *Idaho, *Groundwater recharge, *Groundwater basins, Hydrodynamics, Drainage area, Hydrologic properties, Groundwater movement, Model studies, Prairies, Catchment areas.

A recent tectonic model and subsequent gravity survey and basement modeling have raised questions concerning the size of the Camas Prairie groundwater storage basin and the hydrodynamic properties of the Camas Creek drainage basin. Storage basin dimensions are addressed using an anomalous mass determination from a plot of residual gravity, and estimates of recharge and underflow from a mass-balance study are presented. Underflow may transport much of the water (273,000 acre-ft/yr) calculated as residual in the mass-balance study, and transport is from the Camas Prairie storage basin south to the Snake Plain Aquifer via permeable strata in the Mount Bennett Hills surface drainage divide. Results of the anomalous mass study suggest that the volume of groundwater stored in the Camas Prairie basin is 39,000,000 acre-feet, considerably greater than previously estimated. Similarly, recharge to the Camas Prairie basin is estimated at over 700,000 acre-ft/yr, one order of magnitude greater than earlier estimates. (Author's abstract)
W89-11275

ESTIMATING WATER TABLE ALTITUDES FOR REGIONAL GROUNDWATER FLOW MODELING, U.S. GULF COAST.
Texas Univ. at Austin. Dept. of Geological Sciences.
T. A. Williams, and A. K. Williamson.
Ground Water GRWAAR, Vol. 27, No. 3, p 333-340, May-June 1989. 8 fig, 1 tab, 14 ref.

Descriptors: *Water table, *Groundwater movement, *Hydrologic models, *Model studies, *Topography, *Altitude, *Water level, Mathematical studies, Regression analysis.

Water table altitude, a controlling factor for groundwater flow, was estimated from detailed topographic data by subtracting the estimated depth-to-water. Land surface altitude of the Coastal Plain in the south central United States varies from 0 to more than 800 ft above sea level. Predevelopment depth-to-water in 6,825 wells less than 150 ft deep averages 25.7 ft (standard deviation, 19.5 ft). Most water table altitude variation is due to variation in land surface altitude and not due to variation in depth-to-water. Digital topographic data, from 1:250,000 scale maps for every 30 seconds of latitude and longitude are available for the continental United States. About 90 altitudes were averaged for each 25 square mile block of a rectangular grid used for groundwater flow modeling. Multiple linear regressions of predevelopment water level data and topographic data were used to derive empirical equations relating water table altitude to topography. The regression method was more consistent, efficient, and accurate than manually digitizing values from manually contoured water table maps. Water table maps usually are prepared from few data that are concentrated in topographically flat areas. Manually digitizing water table maps on a regional scale introduced additional error. About 35 percent of the water table altitudes obtained manually were greater than average land surface altitudes from topographic data. The mean difference between water table altitudes from the two methods was less than 10 ft, which indicates no systematic error was incorporated in the regression method. (Author's abstract)
W89-11276

FLUID DENSITY AND GRAVITATIONAL VARIATIONS IN DEEP BOREHOLES AND THEIR EFFECT ON FLUID POTENTIAL.
Hydro-Search, Inc., Reno, NV.
P. L. Oberlander.
Ground Water GRWAAR, Vol. 27, No. 3, p 341-350, May-June 1989. 5 fig, 1 tab, 11 ref.

Descriptors: *Density, *Water table, *Water properties, *Hydraulic properties, *Geohydrology, *Groundwater level, *Hydraulic gradient, Density, Case studies, Boreholes.

As depth below the water table increases, there can be significant spatial variations in fluid density. Fluid density is a function of fluid temperature, total dissolved solids and gases content, fluid compressibility, and the force of gravity. Variations in fluid density can affect the applicability of measured water levels to represent fluid pressure at depth and the existence of a scalar fluid potential. The processes that influence water levels and their representation of fluid potential are reviewed, with sample cases corresponding to hydrologic conditions at three potential high-level nuclear repository sites in the U.S. Where ground water is sufficiently heterogeneous, fluid pressure and fluid density must be known spatially to properly determine the three-dimensional impelling force per unit mass. Assuming that the water level elevation in deep boreholes represents a fluid potential may result in significant errors in determining flow directions and quantities under conditions of a variable density fluid and low hydraulic gradients. Boreholes constructed to investigate the feasibility of deep geologic disposal of nuclear waste have penetrated to depths greater than 1,500 m below the earth's surface. In these deep boreholes, fluid density variations may need to be considered as a part of the hydrologic analysis. Fluid density variations with depth, predicted as general cases based on simple models, indicate the relative importance of temperature, compressibility, and gravity variations at three potential high-level nuclear waste repository locations. Fluid density generally decreases with depth for sites where geothermal gradients are greater than 20 C/km, and thermal expansion can offset the effects of fluid compressibility. (Author's abstract)
W89-11277

GROUNDWATER MODELING FOR SALINITY MANAGEMENT: AN AUSTRALIAN CASE STUDY.
Australian National Univ., Canberra. Centre for Resource and Environmental Studies.
F. Ghassemi, A. J. Jakeman, and G. A. Thomas.
Ground Water GRWAAR, Vol. 27, No. 3, p 384-392, May-June 1989. 6 fig, 15 ref.

Descriptors: *Aquifer management, *Saline water, *Case studies, *Australia, *Water quality control, *Groundwater pollution, *Water management, Groundwater movement, Hydrologic models, Cost analysis, Feasibility studies.

Recognition of the severity of land and stream salinity problems in Australia over the past few decades has resulted in the application of a range of mitigation strategies. In terms of stream salinity management, groundwater interception has proved the most cost-effective strategy, and a number of groundwater interception schemes have not been implemented. In all cases, the scheme design and assessment of feasibility were based on hydrogeological investigations only. Groundwater flow models were developed for subsequent simulation of a range of management options to control groundwater levels and the flow of salt to the River Murray. Using the model to analyze groundwater behavior associated with the Mildura interception scheme, it was found that, over a period of simulation, the intercepton scheme had been operating below this achievable operational effectiveness, 48 compared to 72 percent; effectiveness could be further enhanced to 80 percent by judicious placement of three additional well fields; and improved irrigation practices in the area would significantly reduce the flow of salt to the river. The modeling approach applies to similar river salinity problems elsewhere. (Friedmann-PTT)
W89-11281

IDENTIFYING FRACTURE INTERCONNECTIONS BETWEEN BOREHOLES USING NATURAL TEMPERATURE PROFILING: I. CONCEPTUAL BASIS.
Notre Dame Univ., IN. Dept. of Civil Engineering.
S. Silliman, and R. Robinson.
Ground Water GRWAAR, Vol. 27, No. 3, p 393-402, May-June 1989. 7 fig, 35 ref. USGS Grant 14-08-0001-G1477.

Descriptors: *Tracers, *Geothermal studies, *Geologic fractures, *Geologic fissures, *Boreholes, *Groundwater movement, Geologic formations, Pump wells, Injection wells, Temperature gradient, Tracers.

In situ delineation of fracture characteristics is a difficult and often time-consuming task. A simple technique that provides direct evidence of parameters such as fracture connectivity, fracture orientation, or fracture aperture is presented. The technique is based on utilizing the natural variation of water temperature within the subsurface as a natural groundwater tracer. In this technique, thermal response in observation boreholes induced by local pumping or injection is related to the location of interconnected fractures. The technique provides several advantages including simple equipment and time requirements, direct evidence of fracture flow between boreholes, and the ability to test without contaminating a field site. The major limitations of the technique are related to the volume of fluid movement within an observation hole. These are controlled by the geometry of the flow field in the vicinity of the pumping/injection borehole. In two case studies demonstrating application of the technique to both a fractured granite and a fractured dolomite, borehole temperature response to injection at various depths led successful to profiles of fracture connectivity between boreholes. (Friedmann-PTT)
W89-11282

INFLUENCE OF MINERAL WEATHERING REACTIONS ON THE CHEMICAL COMPOSITION OF SOIL WATER, SPRINGS, AND GROUNDWATER, CATOCTIN MOUNTAINS, MARYLAND.
Geological Survey, Tallahassee, FL.
For primary bibliographic entry see Field 5B.
W89-11288

DISTRIBUTION OF SUBMERGED MACROPHYTES IN LAKE TAHOE, CALIFORNIA AND NEVADA, AND THE POSSIBLE INFLUENCE OF GROUNDWATER SEEPAGE,
Purdue Univ., Lafayette, IN. Dept. of Forestry and Natural Resources.
For primary bibliographic entry see Field 2H.
W89-11320

RELATIONSHIPS BETWEEN SEEPAGE CHEMISTRY AND FLOW PATH THROUGH THE NEAR-SHORE SEDIMENTS OF AN ACIDIC LAKE.
Old Dominion Univ., Norfolk, VA. Dept. of Civil Engineering.
For primary bibliographic entry see Field 5C.
W89-11341

CHEMICAL HYDROGEOLOGY IN NATURAL AND CONTAMINATED ENVIRONMENTS.
Geological Survey, Reston, VA.
For primary bibliographic entry see Field 2K.
W89-11372

HYDROGEOLOGY OF SEDIMENTARY BASINS.
Texas Univ. at Austin. Bureau of Economic Geology.
C. W. Kreitler.
Journal of Hydrology JHYDA7, Vol. 106, No. 1/2, p 29-53, March 30, 1989. 7 fig, 84 ref.

Descriptors: *Geohydrology, *Saline-freshwater interfaces, *Sedimentary basins, *Groundwater, Texas, Recharge, Saline water, Brines.

Observations of the saline groundwater flow in sedimentary basins in Texas are discussed. The Gulf Coast and Palo Duro Basins, Texas, exemplify two end member types of sedimentary basins. The Gulf Coast Basin is a relatively young, tertiary-age basin which is compacting; fluid movement is from the over-pressured, under-compacted sediments up the structural dip or up fault zones into the hydrostatic section, natural fluid pressures are either hydrostatic or overpressured. The Palo Duro is an older, Paleozoic-age basin that has been tectonically uplifted. Fluid flow is gravity driven from topographically high recharge areas to discharge in topographically low areas. Fluid pressures are sub-hydrostatic. Fluids discharge more easily than they are recharged. Not all flow is derived by a simple recharge-discharge model. Brines may flow from other basins into the Palo Duro Basin and waters may discharge from the Palo Duro Basin into other basins. Areal differences in the chemical composition of the basin brines may be the result of different origins. (Author's abstract)
W89-11373

RECONNAISSANCE ESTIMATES OF NATURAL RECHARGE TO DESERT BASINS IN NEVADA, U.S.A., BY USING CHLORIDE-BALANCE CALCULATIONS.
Geological Survey, Carson City, NV.
M. D. Dettinger.
Journal of Hydrology JHYDA7, Vol. 106, No. 1/2, p 55-78, March 30, 1989. 5 fig, 2 tab, 48 ref.

Descriptors: *Chlorides, *Geohydrology, *Recharge, *Groundwater movement, Groundwater, Deserts, Estimating, Surveys, Correlation analysis, Precipitation.

A chloride-balance method for estimating average natural recharge to groundwater basins in the Basin and Range Province of the western United States may be a useful alternative or complement to current techniques. A chloride balance method is presented that equates chloride in recharge water and runoff to chloride deposited in mountainous recharge-source areas by precipitation and dry fallout. Given estimates of annual precipitation on these source areas and chloride concentrations of bulk precipitation and recharge water, the rate of recharge can be estimated providing that: (1) no other major sources of chloride exist, (2) direct runoff to discharge areas in the basin is small or can otherwise be taken into account in the balance, and (3) the recharge sources for the basin are correctly delineated. The estimates are sensitive to the estimated rate of input of chloride from the atmosphere; this is the greatest data need for the future applications of the method. Preliminary applications of the method to sixteen basins in Nevada, including Las Vegas Valley, indicate that the method can be a useful tool for hydrologists and resource managers. Correlation coefficients between recharge efficiencies for the basins--estimated on the basis of recharge estimates that use the chloride-balance method and two other currently used techniques--range from 0.54 to 0.95, depending on assumptions about where the method may be applied. (Author's abstract)
W89-11374

GROUNDWATER LEVEL AND HYDROCHEMISTRY IN THE SAN JACINTO BASIN, RIVERSIDE COUNTY, CALIFORNIA.
California Univ., Riverside. Dept. of Earth Sciences.
M. J. Schelhuber, T. Lee, and B. S. Hall.
Journal of Hydrology JHYDA7, Vol. 106, No. 1/2, p 79-98, March 30, 1989. 12 fig, 1 tab, 17 ref.

Descriptors: *Water chemistry, *Geochemistry, *Geohydrology, *Groundwater level, *Water quality, *California, Sediments, Basins, Hydraulic conductivity, Hydrology, Water level, Sulfates.

Hydrogeological conditions by qualitative assessment of water level and quality data are discussed in terms of aquifer stratigraphy and a water spreading experiment. The San Jacinto basin, structurally a sediment-filled graben (4 km by 40 km) formed by right-stepping en echelon faulting in the right-slipping San Jacinto fault zone, provides most of the water demand in the San Jacinto valley. Pumping of groundwater in the past 80 years had caused the water level to drop at some locations by 90 m. Analysis of seasonal and long-term fluctuations of water levels suggests at least four hydrologic subregimes in the basin. Stiff and Pipper diagrams indicate four major types of subsurface water. Major ion concentrations appear stable over the recorded period from 1951 to 1986 despite repeated changes of water levels in the past 48 years. Hydrologic discontinuities are recognized from contour maps of four-year mean water elevations and four-year mean concentrations of total dissolved solids (TDS). Some discontinuities coincide with faults while others probably signify sedimentary facies boundaries. A trough of low TDS (reflecting ancient channel deposits of high hydraulic conductivity) lies southwest of the present channel of the San Jacinto River. This implies the San Jacinto River has migrated northeast probably in response to tectonic tilting of the basin. That TDS trough also suggests that most of the subsurface water leaves the basin about 7 km south of the present river exit. Because of its mixing with high-TDS water from the northwest, the northwest moving subsurface water appears to have been displaced southward before it exits the basin. Contours of sulfate, which is almost absent in the water from the northwest, provide a better indication of exit location. (Author's abstract)
W89-11375

FLUORINE OCCURRENCE IN GROUNDWATER IN ISRAEL AND ITS SIGNIFICANCE.
Geological Survey of Israel, Jerusalem.
For primary bibliographic entry see Field 2K.
W89-11377

EFFECTS OF VARIATIONS IN RECHARGE ON GROUNDWATER QUALITY.
Kansas State Geological Survey, Lawrence.
For primary bibliographic entry see Field 6G.
W89-11378

CONTINUOUS INFLOW OF SEAWATER AND OUTFLOW OF BRACKISH WATER IN THE SUBSTRATUM OF THE KARSTIC ISLAND OF CEPHALONIA.
Montpellier-2 Univ. (France). Lab. d'Hydrogeologie.
C. Drogue.
Journal of Hydrology JHYDA7, Vol. 106, No. 1/2, p 147-153, March 30, 1989. 4 fig, 20 ref.

Descriptors: *Brackish water, *Saline-freshwater interfaces, *Karst hydrology, *Seawater, Mediterranean Sea, Water currents, Inflow, Outflow, Hydraulic gradient, Density currents, Aegean Sea, Adriatic Sea.

There is massive, continuous inflow of seawater at a place on the coast of the karstic island of Cephalonia in the Mediterranean. This current reappears at the coast on the other side of the island. This is extremely astonishing when it is considered that, for water, sea level represents minimum potential in the earth's gravitational field. The nature of the energy which causes the phenomenon has been the subject of various studies. The proposed explanation is connected with the existence of a marine current which creates a hydraulic gradient between the two sides of the island while maintaining inflow by density flow. Three factors occur simultaneously in this exceptional case and probably contribute to the phenomenon of inflow of sea water and outflow of brackish water. The energy of the Aegean-Adriatic marine current probably causes the phenomenon. Density flow must then accentuate and maintain the movement. The process is made possible by the existence of karstic conduits which were probably formed after the Tertiary period and which lie in a similar direction to that of the marine current. (Miller-PTT)
W89-11379

PRELIMINARY HYDROGEOLOGIC EVALUATION OF THE CINCINNATI ARCH REGION FOR UNDERGROUND HIGH-LEVEL RADIOACTIVE WASTE DISPOSAL, INDIANA, KENTUCKY, AND OHIO.
Geological Survey, Raleigh, NC. Water Resources Div.
O. B. Lloyd, and R. W. Davis.
Available from Books and Open File Report Section, USGS, Box 25425, Denver, CO 80225. USGS Water-Resources Investigations Report 88-4098, 1989. 42p, 9 fig, 2 pl, 3 tab, 39 ref.

Descriptors: *Underground waste disposal, *Geohydrology, *Injection wells, *Radioactive waste disposal, *Aquifer systems, *Indiana, *Kentucky, *Ohio, Cincinnati Arch, Groundwater quality, Groundwater movement.

Preliminary interpretation of available hydrogeologic data suggests that some areas underlying eastern Indiana, north-central Kentucky, and western Ohio might be worthy of further study regarding the disposal of high-level radioactive waste in Precambrian crystalline rocks buried beneath Paleozoic sedimentary rocks in the area. The data indicate that (1) largest areas of deepest potential burial and thickest sedimentary rock cover occur in eastern Indiana; (2) highest concentrations of dissolved solids in the basal sandstone aquifer, suggesting the most restricted circulation, are found in the southern part of the area near the Kentucky-Ohio State line and in southeastern Indiana; (3) largest areas of lowest porosity in the basal sandstone aquifer, low porosity taken as an indicator of the lowest groundwater flow velocity and contaminant migration, are found in northeastern Indiana and northwestern Ohio, central and southeastern Indiana, and central Kentucky; (4) the thickest confining units that directly overlie the basal sandstone aquifer are found in central Kentucky and eastern Indiana where their thickness exceeds 500 ft; (5) steeply dipping faults that form potential hydraulic connections between crystalline rock, the basal sandstone aquifer, and the freshwater circulation system occur on the boundaries of the study area mainly in central Kentucky and central Indiana. Collectively, these data indicate that the hydrogeology of the sedimentary rocks in the western part of the study area is more favorably suited than that in the remainder of the area for the application of the buried crystalline-rock concept. (USGS)
W89-11479

APPROXIMATE WATER LEVEL CHANGES IN WELLS COMPLETED IN THE CHICOT AND EVANGELINE AQUIFERS, 1977-89 AND 1988-89, AND MEASURED COMPACTION, 1973-89, IN THE HOUSTON-GALVESTON REGION, TEXAS.
Geological Survey, Austin, TX. Water Resources Div.
For primary bibliographic entry see Field 7C.
W89-11480

MAPS SHOWING ALTITUDE OF THE POTENTIOMETRIC SURFACE AND CHANGES IN WATER LEVELS IN THE SPARTA-MEMPHIS AQUIFER IN EASTERN AND SOUTHERN ARKANSAS, SPRING 1986.
Geological Survey, Little Rock, AR. Water Resources Div.
For primary bibliographic entry see Field 7C.
W89-11481

HYDROLOGIC CONDITIONS AT THE IDAHO NATIONAL ENGINEERING LABORATORY, 1982 TO 1985.
Geological Survey, Idaho Falls, ID. Water Resources Div.
For primary bibliographic entry see Field 5B.
W89-11482

AQUIFER-SYSTEM COMPACTION, TUCSON BASIN AND AVRA VALLEY, ARIZONA.
Geological Survey, Tucson, AZ. Water Resources Div.
R. T. Hanson.
Available from Books and Open File Report Section, USGS, Box 25425, Denver, CO 80225. USGS Water-Resources Investigations Report 88-4172, 1989. 69p, 27 fig, 3 tab, 71 ref.

Descriptors: *Compaction, *Subsidence, *Aquifer characteristics, *Tucson Basin, *Avra Valley, *Arizona, Stress, Extensometer, Model studies, Computer models, Aquitards, Santa Cruz Valley, Pima County, Pinal County.

Groundwater declines of several ft/yr since the 1940's have induced aquifer-system compaction and land subsidence of as much as 0.5 ft in the Tucson basin and 1.1 ft in Avra Valley, Arizona. Aquifer system compaction is affected by the layering, hydraulic diffusivity, preconsolidation-stress threshold, and stress history of the aquifer system. Layering at extensometer sites can be categorized into three general groups that typify the fine-grained and coarse-grained layering within the Fort Lowell Formation and upper Tinaja beds. Data from the first group show almost as much elastic as inelastic compaction, a layering frequency of six layers/100 ft, and weighted-average aquitard thicknesses of 20 to 50 ft. Data from the second group show inelastic compaction, a layering frequency of two to three layers/100 ft, an average aquitard thickness of less than 20 ft. Data from the third group show inelastic compaction, a layering frequency of fewer than two layers/100 ft, an average aquitard thickness of more than 30 ft. A one-dimensional compaction model was applied to data from six extensometers to simulate aquifer-system compaction of less than 0.1 ft. Values of elastic and some values of inelastic specific storage are comparable to values estimated in California. Parts of the aquifer system appear to be in transition from predominantly elastic to inelastic compaction. Water level declines since 1940 at six extensometer sites are within an estimated preconsolidation-stress threshold of 50 to 150 ft. (USGS)
W89-11483

HYDROGEOLOGY OF THE WESTERN PART OF THE SALT RIVER VALLEY AREA, MARICOPA COUNTY, ARIZONA.
Geological Survey, Tucson, AZ. Water Resources Div.
J. G. Brown, and D. R. Pool.
Available from Books and Open File Report Section, USGS, Box 25425, Denver, CO 80225. USGS Water-Resources Investigations Report 88-4202, 1989. 5 sheets (maps) 21 fig, 1 tab, 61 ref.

Descriptors: *Groundwater, *Aquifer characteristics, *Geohydrology, *Maps, *Salt River Valley, *Arizona, Aquifers, Sedimentary basins, Geologic history, Structural geology, Particle size, Lithologic logs, Water quality, Phoenix.

The rocks in the western Salt River Valley were divided into six units on the basis of lithology, geologic structure, and water-bearing characteristics. Highly impermeable Precambrian to Middle Tertiary metamorphic and granitic rocks make up most of the surrounding mountains and underlie the aquifer. Middle Tertiary to Quaternary volcanic rocks locally overlie the metamorphic and granitic rocks and may be interbedded with basin fill. The Middle Tertiary red unit, which was deposited before the Basin and Range disturbance, consists of indurated sediments and is not a source of water. The aquifer includes unconsolidated to well-consolidated mud, silt, clay, sand, and gravel and was subdivided into lower, middle, and upper units that range in age from Middle Tertiary to Quaternary. The lower unit, which contains evaporites is the oldest basin-fill unit and unconformably overlies the metamorphic and granitic rocks. The middle unit overlies and is less extensively faulted than the lower unit. The lower and middle units were deposited in a closed basin; the upper unit was deposited after the development of integrated drainage. Estimates of hydraulic conductivity range from 3 to 24 ft/day in the lower unit, from 4 to 60 ft/day in the middle unit, and from 180 to 1,700 ft/day in the upper unit. Dissolved-solids concentrations in the groundwater range from 200 mg/L near recharge areas to more than 100,000 mg/L near the Luke salt body. Locally, concentrations of fluoride and nitrate in the groundwater exceed drinking water standards. (USGS)
W89-11484

POTENTIOMETRIC SURFACE OF THE AQUIA AQUIFER IN SOUTHERN MARYLAND DURING THE FALL OF 1987.
Geological Survey, Towson, MD. Water Resources Div.
For primary bibliographic entry see Field 7C.
W89-11485

POTENTIOMETRIC SURFACE OF THE MAGOTHY AQUIFER IN SOUTHERN MARYLAND DURING THE FALL OF 1987.
Geological Survey, Towson, MD. Water Resources Div.
For primary bibliographic entry see Field 7C.
W89-11486

LITHOLOGIC, GEOPHYSICAL, AND WELL-CONSTRUCTION DATA FOR OBSERVATION WELLS IN THE MELTON VALLEY AREA, OAK RIDGE RESERVATION, TENNESSEE.
Geological Survey, Nashville, TN. Water Resources Div.
P. Tucci, and D. W. Hanchar.
Available from Books and Open File Report Section, USGS, Box 25425, Denver, CO 80225. USGS Water-Resources Investigations Report 88-4197, 1989. 22p, 10 fig, 1 tab, 6 ref.

Descriptors: *Borehole geophysics, *Geologic fractures, *Tennessee, *Geologic units, *Observation wells, *Well logs, *Oak Ridge, Cores, Density logs, Gamma logs, Logging(Recording), Radioactive well logging, Well data, Core logging, Melton Valley.

Nineteen wells were installed at nine sites in the Melton Valley area. The wells are intended to provide information on water levels in both regolith and bedrock, aquifer characteristics, and subsurface lithology. Well depths range from 24 to 86 ft for shallow wells, and from 126 to 301 ft for deep wells. Four inch diameter cores were obtained from four of the deep wells. Caliper, gamma, neutron, and gamma-gamma density borehole geophysical logs were obtained for each deep well. Lithologic description of cores and analysis of geophysical logs indicate that one deep well (UA2) is completed entirely within the Nolichucky Shale; one deep well (UD2) is completely entirely within the Pumpkin Valley Shale; two deep wells (UB2, UE2) are completed entirely within the Maryville Limestone; four deep wells (UF2, UG2, UH2, UI2) penetrate both the Nolichucky Shale and the Maryville Limestone. Well UC2, located near the crest of Haw Ridge, penetrates an imbricate splay of the Copper Creek thrust fault, which places the older Rome Formation above the younger Chickamauga Limestone, at a depth of about 100 to 117 ft. (USGS)
W89-11492

ALTITUDE AND CONFIGURATION OF THE POTENTIOMETRIC SURFACE IN THE TRIASSIC SANDSTONES AND SHALES, NORTHEASTERN CHESTER COUNTY, PENNSYLVANIA, SEPTEMBER 1987 THROUGH JANUARY 1988.
Geological Survey, Malvern, PA. Water Resources Div.
For primary bibliographic entry see Field 7C.
W89-11493

EFFECT OF LOW ELECTROLYTE CONCENTRATION ON HYDRAULIC CONDUCTIVITY OF CLAY-SAND-HYDROXY POLYMERS SYSTEMS.
Volcani Inst. of Agricultural Research, Bet-Dagan (Israel). Inst. of Soil and Water.
For primary bibliographic entry see Field 2G.
W89-11573

RADIATION EFFECTS ON CHEMISTRY.
Battelle Pacific Northwest Labs., Richland, WA.
For primary bibliographic entry see Field 5E.
W89-11590

BIODEGRADATION OF TRANS-1,2-DICHLOROETHYLENE BY METHANE-UTILIZING BACTERIA IN AN AQUIFER SIMULATOR.
C.A.A. Bioremediation Systems, Boston, MA.
For primary bibliographic entry see Field 5G.
W89-11593

SUBSURFACE TRANSPORT OF CONTAMINANTS.
Oak Ridge National Lab., TN.
For primary bibliographic entry see Field 5B.
W89-11616

AIR STRIPPING REMOVES PETROLEUM FROM GROUNDWATER.
Agway, Inc., Syracuse, NY.
For primary bibliographic entry see Field 5G.
W89-11633

SOURCES AND FLOW OF NORTH CANTERBURY PLAINS GROUNDWATER, NEW ZEALAND.
Institute of Nuclear Sciences, Lower Hutt (New Zealand).
C. B. Taylor, D. D. Wilson, L. J. Brown, M. K. Stewart, and R. J. Burden.
Journal of Hydrology JHYDA7, Vol. 106, No. 3/4, p 311-340, April 20 1989. 12 fig, 15 ref, append.

Descriptors: *Geohydrology, *Tracers, *Surface-groundwater relations, *New Zealand, *Groundwater movement, *Groundwater recharge, Confined aquifers, Flow pattern, Isotopic tracers, Aquifers, Glacial sediments, Groundwater pollution.

Geological, hydrological, isotope (tritium and O18) and chemical (mainly nitrate and chloride concentrations) evidence is interpreted to give a mutually consistent picture of the recharge sources and flow pattern so the important groundwater resource in the deep glacial and interglacial deposits of the sector of the Canterbury Plains between the Selwyn River and Ashley River, especially the confined gravel aquifers that presently provide about 300,000 cu m daily of mainly very high quality water for the needs of Christchurch city. The 27-year study of tritium measurements encompasses the peak and decline of thermonuclear tritium fallout in this region. Major rivers emerging from the hill and mountain catchments to the west of the Plains are depleted in O18 relative to average low-level precipitation. Most of the groundwater is river-recharged, but some areas of significant local precipitation recharge contribution are clearly identified by O18 and chemical concentrations. The pressure distribution, tritium and chemical data reveal that the artesian groundwater underlying Christchurch ascends from deeper aquifers into the shallowest aquifer via gaps in the confining layers; much of this flow is induced by withdrawal, and the data reveal nothing about possible offshore discharge through the seaward extension of the shallowest aquifer, which is known to outcrop 40 km beyond the coast. The Christchurch aquifers are recharged by infiltration from Waimakariri River in its central Plains reaches, and the resulting flow regime is east and southeast-directed; satisfactory water quality of the deeper Christchurch aquifers appears to be guaranteed for the future provided the river can be maintained in its present condition. Shallow groundwater, and water recharged to depth by other rivers, irrigation and local precipitation on the unconfined western areas of the Plains, are more susceptible to agricultural and other pollutants; none of this water is encountered in the deeper aquifers under Christchurch, but only in shallow aquifers and surface discharges, or else flowing to the southeast, well away from the area. (Author's abstract)
W89-11682

HYDROLOGY AND WATER QUALITY ASPECTS OF RHINE BANK GROUNDWATER IN THE NETHERLANDS.
Keuringsinstituut voor Waterleidingartikelen, Rijswijk (Netherlands).
P. J. Stuyfzand.
Journal of Hydrology JHYDA7, Vol. 106, No. 3/4, p 341-363, April 20 1989. 14 fig, 5 tab, 46 ref.

Descriptors: *Water pollution sources, *Groundwater quality, *Surface-groundwater relations, *The Netherlands, *Water quality, *Geohydrology, *Groundwater recharge, *Rhine River, Groundwater pollution, Groundwater, Infiltration, Isotope studies, Glacial aquifers, Tritium, Oxygen isotopes.

In deltaic areas with deep polders and in valleys or deltas with heavy groundwater exploitation, bank infiltration is a rapidly expanding mechanism of groundwater recharge. Rhine bank filtrate can be distinguished best from autochthonous groundwater in The Netherlands by way of its natural lower O18 content. Tritium is a good measure of the portion of water younger than 25 years, at least in well mixed Rhine bank filtrate. This portion carries the bulk of the contaminations originating from the Rhine, as evidenced by strong positive correlations between H3 and, e.g., halogenated hydrocarbons, taste and mutagenic activity according to the Ames test. The composition of Rhine bank filtrate is further governed by the redox level of the hydrogeochemical system, varying in The Netherlands from suboxic to anoxic with fermentation, and by the underground distance to the influent Rhine branch. Anoxic bank filtrate with strong SO4-reduction and CH4 > 1 mg/l exhibited a significantly different composition from anoxic bank filtrate without fermentation and without SO4-reduction. The following parameters are involved: HCO3, total dissolved solids, Di)2; KMnO4-consumption, NH4, siderite, baryte and vivianite saturation indices, I, total hardness, total PO4, Fe, dissolved organic carbon, Ba, pH, dichloroethane, Mo, VOCl, Mn, V, dichlorobenzene and 1,2-dichloroethane, in order of decreasing significance. A longer underground detention time or travel distance, leads to a small decrease in the share of bank filtrate, and a rather strong decrease in K, Li, F, temperature, Mo (only in anoxic, SO4-(meta)stable bank filtrate), UV-extinction, AOCl, X7OCl and mutagenic activity. Coli bacteria and viruses could not be detected, even in samples from wells at 50 m distance from the Rhine, with a minimum travel time of 30 d. (Author's abstract)
W89-11683

GENERALIZED TWO-DIMENSIONAL ANALYTICAL SOLUTION FOR HYDRODYNAMIC DISPERSION IN BOUNDED MEDIA WITH THE FIRST-TYPE BOUNDARY CONDITION AT THE SOURCE,
International Technology Corp., Monroeville, PA.
For primary bibliographic entry see Field 5B.
W89-11755

SYMMETRIC-MATRIX TIME INTEGRATION SCHEME FOR THE EFFICIENT SOLUTION OF ADVECTION-DISPERSION PROBLEMS,
Karlsruhe Univ. (Germany, F.R.). Inst. fuer Hydromechanik.
For primary bibliographic entry see Field 5B.
W89-11756

CONTAMINANT TRANSPORT AND BIODEGRADATION: 1. A NUMERICAL MODEL FOR REACTIVE TRANSPORT IN POROUS MEDIA.
Massachusetts Inst. of Tech., Cambridge. Dept. of Civil Engineering.
For primary bibliographic entry see Field 5B.
W89-11757

CONTAMINANT TRANSPORT AND BIODEGRADATION: 2. CONCEPTUAL MODEL AND TEST SIMULATIONS.
Golder Associates, Inc., Redmond, WA.
For primary bibliographic entry see Field 5B.
W89-11758

ANALYTICAL MODEL OF CONTAMINANT TRANSPORT FROM DIFFUSE SOURCES IN SATURATED POROUS MEDIA,
Commonwealth Scientific and Industrial Research Organization, Adelaide (Australia). Div. of Water Resources.
For primary bibliographic entry see Field 5B.
W89-11762

METHODS FOR DETERMINING TRANSVERSE DISPERSION COEFFICIENTS OF POROUS MEDIA IN LABORATORY COLUMN EXPERIMENTS.
Connecticut Univ., Storrs. Dept. of Geology and Geophysics.
G. A. Robbins.
Water Resources Research WRERAO, Vol. 25, No. 6, p 1249-1258, June 1989. 8 fig, 6 tab, 22 ref.

Descriptors: *Groundwater movement, *Dispersion, *Porous media, *Saturated flow, *Solute transport, *Tracers, Dispersion coefficient, Water tanks, Cores, Laboratory equipment.

Continuous point source and instantaneous finite source methods are presented for determining the transverse dispersion coefficient of saturated porous media in laboratory column experiments. The methods entail injecting a conservative tracer from an injector embedded in a porous medium, monitoring concentration variations with time within the column upgradient from where the tracer impinges the column wall, and extracting longitudinal and transverse dispersion coefficient values from relative concentration-time data using three-dimensional advection-dispersion formulations. The methods were tested in a column packed with glass beads for comparison with reported flow tank tests. The transverse dispersion coefficient values calculated using column test data agree closely with flow tank results. The methods presented offer new approaches for investigating dispersion phenomena in porous media and especially offer the potential for determining the transverse as well as the longitudinal dispersion coefficient of undisturbed core samples. (Author's abstract)
W89-11766

SOLUTE ADVECTION IN STRATIFIED FORMATIONS.
Royal Inst. of Tech., Stockholm (Sweden).
V. D. Cvetkovic, and A. M. Shapiro.
Water Resources Research WRERAO, Vol. 25, No. 6, p 1283-1289, June 1989. 8 fig, 21 ref.

Descriptors: *Path of pollutants, *Advection, *Solute transport, *Groundwater movement, *Stratification, Particulate matter, Hydraulic conductivity, Porosity.

Advection-dominated solute movement in stratified formations was investigated using a Lagrangian interpretation of particle motion. A probability density function (pdf) for particle position quantifies the expected depth-integrated resident concentration. A pdf for particle arrival time quantifies the expected depth-integrated rate of mass arrival, from which the flux-averaged concentration can be defined. The difference between the flux-averaged and resident concentrations is shown to be significant for the variability in the hydraulic conductivity that is commonly encountered in field applications. The influence of porosity variations on the advection-dominated solute movement in stratified porous media is shown to be notable only for large variability in effective porosity. (Author's abstract)
W89-11769

OPTIMAL CONTROL OF GROUNDWATER BY THE FEEDBACK METHOD OF CONTROL.
California Univ., Davis. Dept. of Land, Air and Water Resources.
For primary bibliographic entry see Field 4B.
W89-11774

EVALUATION OF MATHEMATICAL MODELS OF THE TRANSPORT OF BIOLOGICALLY REACTING SOLUTES IN SATURATED SOILS AND AQUIFERS,
Illinois Univ. at Urbana-Champaign. Dept. of Agronomy.
For primary bibliographic entry see Field 5B.
W89-11780

NUMERICAL INVESTIGATION OF THE CONJUGATE GRADIENT METHOD AS APPLIED TO THREE-DIMENSIONAL GROUNDWATER FLOW PROBLEMS IN RANDOMLY HETEROGENEOUS POROUS MEDIA,
Illinois Univ. at Urbana-Champaign. Dept. of Civil Engineering.

For primary bibliographic entry see Field 7C.
W89-11783

MATHEMATICAL ANALYSIS OF ARTIFICIAL RECHARGE FROM BASINS.
Colorado State Univ., Fort Collins.
For primary bibliographic entry see Field 4B.
W89-11803

TRANSITIONS IN MIDWESTERN GROUND WATER LAW.
Illinois State Water Survey Div., Champaign.
For primary bibliographic entry see Field 6E.
W89-11804

PRELIMINARY REPORT ON GROUND-WATER RESOURCES OF THE CHICAGO REGION, ILLINOIS.
Illinois State Water Survey, Urbana.
M. Suter, R. E. Bergstrom, H. F. Smith, G. H. Emrich, and W. C. Walton.
Illinois State Water Survey Cooperative Ground-Water Report I, 1959. 89p, 50 fig, 26 tab, 40 ref, 2 append.

Descriptors: *Groundwater potential, *Groundwater resources, *Water resources data, *Illinois, *Chicago, Groundwater budget, Groundwater management, Aquifers, Glacial aquifers, Dolomite, Groundwater mining, Water resources development, Groundwater depletion, Groundwater quality.

Groundwater resources in the Chicago region of Illinois are developed from four water yielding units: (1) glacial drift aquifers; (2) shallow dolomite aquifers; (3) Cambrian-Ordovician aquifer; and (4) the Mt. Simon Aquifer. The Cambrian-Ordovician Aquifer has been the most highly developed source of large groundwater supplies. Its estimated yield in 1958 of > 43 million gallons/day (mgd) approaches the amount that can be withdrawn without dewatering the Ironton-Galesville Sandstone, the lowermost and most productive formation in the aquifer. Artesian pressure in the Cambrian-Ordovician Aquifer at Chicago has declined as much as 660 ft since 1864 as a result of pumpage. The glacial drift and shallow dolomite aquifers yielded more than half of the 127.9 mgd of groundwater pumped in the region in 1957. This withdrawal resulted in no general decline in nonpumping water levels, indicating that the potential yield is considerably larger than present withdrawal. Future groundwater supplies should be taken from the shallow aquifers wherever possible. (Author's abstract)
W89-11883

GROUND-WATER RESOURCES OF JASPER AND NEWTON COUNTIES, TEXAS.
J. B. Wesselman.
Texas Water Development Board Report 59, September 1967. 167p, 31 fig, 7 tab, 46 ref.

Descriptors: *Groundwater potential, *Aquifer characteristics, *Water resources data, *Texas, *Newton County, *Jasper County, Aquifers, Groundwater recharge, Permeability, Groundwater level, Evangeline Aquifer, Jasper Aquifer, Chicot Aquifer, Geohydrology, Groundwater quality, Saline water intrusion, Groundwater depletion, Groundwater budget.

Large quantities of fresh water are present in the aquifers of Jasper and Newton Counties. Depth from the land surface to the base of fresh water--water containing < 1,000 parts per million (ppm) of dissolved solids--varies from possibly zero in a small area of northwestern Jasper County to > 3,000 ft in the central parts of both counties, and is about 1,000 ft along the southern boundary of the report area. About 45% of the sediments to these depths are sands that will yield fresh water to wells. Under present conditions (1966), it is estimated that an average of at least 500 million gallons per day (mgd) of fresh water infiltrates the outcrops of the aquifers. Use of the groundwater in the report area was about 52 mgd in 1965. The geologic and hydrologic units that yield fresh or slightly saline water (water containing 1,000 to 3,000 ppm of dissolved solids) to wells in Jasper and Newton counties are: The Yegua Formation; the Jackson Group; the Catahoula Sandstone; and the Jasper, Evangeline, and Chicot aquifers. The average coefficients of permeability range from 260 to 1,322 gallons per day (gpd)/sq ft. Water levels in all the aquifers have been lowered to some extent. The greatest decline, about 200 ft, has been in the Evangeline aquifer in the southwestern part of Jasper County. The chemical quality of most of the groundwater in the report area is excellent. Many users of the water have had 'iron' problems, but workable remedies are being applied. Contamination is and has been a minor problem. Large quantities of slightly to very saline water exist downdip from the fresh water. Waters of this type move updip when the pressure head of the fresh water bearing part of the aquifers is reduced. (Lantz-PTT)
W89-11890

PROCEEDINGS OF THE FOCUS CONFERENCE ON EASTERN REGIONAL GROUND WATER ISSUES.
September 27-29, 1988, Stamford, Connecticut. National Water Well Association, Dublin, Ohio, 1988. 648p.

Descriptors: *Groundwater pollution, *Groundwater management, *Conferences, Water pollution effects, Agriculture, Groundwater quality, Aquifers, Geohydrology, Radioactivity, Aeration zone, Monitoring, Water quality control.

The fifth annual FOCUS Conference on Eastern Regional Ground Water Issues addressed many important groundwater issues in the northeastern region of North America. Sessions were devoted to: investigative techniques in groundwater, groundwater contamination and liability, agricultural and domestic impacts on groundwater, monitoring well construction, dealing with underground storage tanks, aquifer restoration and remedial action, eastern groundwater management, glacial geology/hard rock, radioactivity in groundwater and unsaturated zone investigations. Government officials, geohydrologists, consulting engineers, geologists, geochemists and industry representatives attended the meeting. They were pleased with the quality of papers and the opportunity to exchange information and ideas with their peers. This bound volume of proceedings contains the papers that were presented at the meeting. (See W89-11916 thru W89-11952) (Author's abstract)
W89-11916

ELECTROMAGNETIC DATA INTERPRETATION USING MULTIVARIATE LEAST-SQUARES REGRESSION.
Soil Testing Engineers, Inc., Baton Rouge, LA.
For primary bibliographic entry see Field 7C.
W89-11917

APPLICATION OF CROSS-WELL VOLTAGE MEASUREMENTS FOR ASSESSING FRACTURE FLOW HYDROLOGY.
Connecticut Univ., Storrs. Dept. of Geology and Geophysics.
For primary bibliographic entry see Field 7B.
W89-11918

APPLYING SEISMIC REFLECTION TECHNIQUES TO HYDROGEOLOGICAL INVESTIGATIONS.
Gartner Lee, Inc., Niagara Falls, NY.
For primary bibliographic entry see Field 7B.
W89-11919

GROUNDWATER MONITORING IN KARSTIC TERRAIN: A CASE STUDY OF A LANDFILL IN NORTHERN NEW YORK.
Stearns and Wheeler, Cazenovia, NY.
T. R. Byrnes, and D. W. Stoner.
IN: Proceedings of the FOCUS Conference on Eastern Regional Ground Water Issues, September 27-29, 1988, Stamford, Connecticut. National Water Well Association, Dublin, Ohio, 1988. p 53-76, 10 fig, 2 tab, 9 ref.

Descriptors: *Leaching, *Path of pollutants, *Monitoring, *Karst hydrology, *Landfills, *Groundwater pollution, *Groundwater quality, Case studies, Groundwater budget, New York, Geophysics, Bedrock, Radar.

The City of Watertown, New York, operates an 80 acre unlined municipal landfill overlying karstic limestone. This geologic environment posed special problems for the design of an effective groundwater monitoring system. Caves, sinkholes and disappearing streams were found in the immediate vicinity of the landfill. If large solutional openings exist in the bedrock beneath the landfill, they would act as conduits for leachate flow. In order to effectively monitor groundwater quality, these openings needed to be located. A combination of several geophysical methods, fracture trace analysis, and field surveys were used to site monitoring wells. Field investigations began with mapping and study of bedrock exposures in the landfill area. Next, shallow borings determined the nature of the overburden and depth to bedrock. This information was used to choose the most appropriate geophysical methods to use to detect large vertical openings in the bedrock. The Geonics EM16 and EM34-3XL were used with limited success where depth to bedrock was not > 10 to 15 ft. Where depth to bedrock was< 10 ft, ground-penetrating radar (GPR) was used to verify the EM34XL results. Overall, significant anomalies detected with the EM34XL tended to coincide with fracture traces identified on old aerial photographs of the area predating the landfill. The use of several geophysical techniques was most successful as a reconnaissance tool, in combination with other methods of investigation, to aid in the efficient placement of monitoring wells in a complex geologic environment. (See also W89-11916) (Author's abstract)
W89-11920

USE OF GROUND-PENETRATING RADAR IN DEFINING GLACIAL OUTWASH AQUIFERS.
BCI Geonetics, Inc., Laconia, NH.
For primary bibliographic entry see Field 7B.
W89-11921

PREDICTING AND TRACING LOW LEVEL VOLATILE CONTAMINANTS: A CASE STUDY.
Gerber (Robert G.), Inc., Freeport, ME.
For primary bibliographic entry see Field 5B.
W89-11923

ETHYLENE THIOUREA IN MAINE GROUND WATER.
Maine Geological Survey, Augusta.
For primary bibliographic entry see Field 5B.
W89-11925

POTENTIAL NITRATE CONTAMINATION OF SHALLOW GROUND WATER FOLLOWING CHEMICAL REHABILITATION OF A SEPTIC SYSTEM.
Illinois Univ., Urbana. Dept. of Agronomy.
For primary bibliographic entry see Field 5B.
W89-11926

PREDICTING NITROGEN CONCENTRATIONS IN GROUND WATER-AN ANALYTICAL MODEL.
IEP, Inc., Sandwich, MA.
For primary bibliographic entry see Field 5B.
W89-11927

ABANDONMENT OF GROUNDWATER MONITORING WELLS AT THE SAVANNAH RIVER PLANT, AIKEN, SOUTH CAROLINA.
Du Pont de Nemours (E.I.) and Co., Aiken, SC. Savannah River Plant.
For primary bibliographic entry see Field 5G.
W89-11929

REDUCTION OF VOLATILE ORGANIC COMPOUND LEVELS IN SOILS AND GROUND WATER USING IN-GROUND SOIL VENTING.
IEP, Inc., Northborough, MA.
For primary bibliographic entry see Field 5G.
W89-11931

MULTIOBJECTIVE ANALYSIS OF A COMPLEX AQUIFER SYSTEM CONTAMINATED WITH DENSE CHLORINATED HYDROCARBONS AND HEAVY METALS.
HMM Associates, Inc., Concord, MA.
For primary bibliographic entry see Field 5B.
W89-11932

CREATION OF AN ARTIFICIALLY PRODUCED FRACTURE ZONE TO PREVENT CONTAMINATED GROUNDWATER MIGRATION.
Dunn Geoscience Corp., Albany, NY.
For primary bibliographic entry see Field 5G.
W89-11933

CAPTURE ZONE DESIGN USING SIMULATION MODELS AND OPTIMIZATION TECHNIQUES.
Connecticut Univ., Storrs. Environmental Research Inst.
For primary bibliographic entry see Field 5G.
W89-11934

RAPID RISE OF SHALLOW GROUNDWATER TABLES ON INFILTRATION-PRELIMINARY RESULTS AND IMPLICATIONS ON AQUIFER CONTAMINATION.
Rutgers - The State Univ., New Brunswick, NJ.
P. F. Germann, and S. M. Gupte.
IN: Proceedings of the FOCUS Conference on Eastern Regional Ground Water Issues, September 27-29, 1988, Stamford, Connecticut. National Water Well Association, Dublin, Ohio, 1988. p 325-338, 5 fig, 1 tab, 23 ref. NJAES Project 15235.

Descriptors: *Water table rise, *Model studies, *Groundwater level, *Infiltration, *Groundwater movement, *Groundwater pollution, Path of pollutants, Soil horizons, Water table, Water level fluctuations, Kinematic wave theory.

A method of estimating macropore flow parameters for studying infiltration in situ is based on kinematic wave theory. The resulting model comprises a set of analytical equations which can be easily solved for a broad variety of transient flow situations. The field equipment required to experimentally determine the flow parameters include a double ring infiltrometer, a neutron meter and a sensitive recording piezometer. A rapid rise of the shallow water table underneath and nearby the confinement is attributed to preferred flow. The profiles of volumetric soil moisture increases with respect to the moisture content immediately before infiltration. All profiles but the last one are characterized by the bulk of increase near the soil surface and some increase at the lowest two horizons where the water content did not increase more than 0.028. Only at a much later time, when the matrix wetting front had arrived at the two lowest horizons, did the water content increase. The early and limited moisture increase below the 1.4 m depth indicates that the rapid rise of the water table is not only due to a pressure wave, but also due to mass flow of water to this depth. (See also W89-11916) (Lantz-PTT)
W89-11935

REMOVAL OF PETROLEUM HYDROCARBONS AND MTBE FROM WATER BY A MULTI-STAGED POE AERATION SYSTEM.
Lowry Engineering, Inc., Unity, ME.
For primary bibliographic entry see Field 5D.
W89-11936

EVALUATING HOMEOWNERS' GROUND WATER TREATMENT OPTIONS.
Pennsylvania State Univ., University Park. Dept. of Agricultural Economics and Rural Sociology.
For primary bibliographic entry see Field 5F.
W89-11938

RELIABILITY OF GROUNDWATER MODELING FOR THE ANALYSIS OF QUARRY DEWATERING.
Dunn Geoscience Corp., Albany, NY.
For primary bibliographic entry see Field 4C.
W89-11939

GROUNDWATER PROTECTION INITIATIVES FOR THE PUBLIC DRINKING WATER SUPPLY IN THE TOWN OF CHESHIRE, CONNECTICUT.
South Central Connecticut Regional Water Authority, New Haven.
For primary bibliographic entry see Field 6E.
W89-11940

DETERMINATION OF SAFE YIELD FOR PUBLIC SUPPLY WELL FIELDS IMPACTED BY SALT-WATER UPCONING IN EASTERN LONG ISLAND.
Leggette, Brashears and Graham, Inc., Wilton, CT.
For primary bibliographic entry see Field 4B.
W89-11943

GROUND WATER IN AN UPLAND VALLEY, THE LINGERING INFLUENCE OF A GLACIAL LAKE: WILLIAMSTOWN, MASSACHUSETTS.
Washington Univ., Seattle. Dept. of Geological Sciences.
P. Bierman, L. Marler, and B. Martin.
IN: Proceedings of the FOCUS Conference on Eastern Regional Ground Water Issues, September 27-29, 1988, Stamford, Connecticut. National Water Well Association, Dublin, Ohio, 1988. p 513-537, 14 fig, 1 tab, 12 ref.

Descriptors: *Glacial aquifers, *Geohydrology, *Glacial lakes, *Surface-groundwater relations, *Massachusetts, *Geohydrology, Aquifers, Stratigraphy, Chemical analysis, Groundwater quality, Glacial sediments, Model studies, Mapping, Literature review.

On the basis of subsurface investigation, surficial mapping, aquifer testing, and consideration of geologic processes, a qualitative model is proposed relating Quaternary stratigraphy to the distribution of groundwater. The study indicates that the geometry of the retreating ice margin and the resulting distribution of glaciofluvial, glaciolacustrine, and alluvial sediment control the occurrence of groundwater. Because similar stratigraphy has been reported throughout New England, the model should be useful for planning and interpreting geohydrologic investigations in other previously glaciated, upland valleys. This investigation delineated three geohydrologic units overlying dolomictic bedrock: an unconfined aquifer in alluvium; a glaciolacustrine aquitard of varying integrity, and a confined aquifer in glaciofluvial deposits. Chemical analyses of numerous groundwater samples indicate that contamination is restricted to the uppermost aquifer and has not affected the deeper aquifer which is used as a public water supply. Glaciolacustrine sediment is sufficiently impermeable near several landfills to maintain upward hydraulic gradients between the two aquifers and to prevent downward migration of contaminated water. The model predicts that permeable, glaciofluvial sand and gravel overlie bedrock or till and underlie a glaciolacustrine aquitard. The lacustrine sediment is coarser or thinner, and less able to confine the lower aquifer, in the proximity of former ice margins, near valley walls, where streams entered the lake, or where the aquitard has been eroded. Research suggests that a thorough literature survey, mapping of surface drainages, and identification of outwash heads could direct and enhance the efficiency of subsurface investigation. (See also W89-11916) (Author's abstract)
W89-11945

TRANSPORT OF A NON-AQUEOUS PHASE LIQUID WITHIN A COMBINED PERCHED AND WATER TABLE AQUIFER SYSTEM.
Environmental Resources Management, Inc., Exton, PA.
For primary bibliographic entry see Field 5B.
W89-11946

AIR-LIFT DEVELOPMENT SYSTEM FOR DEEP WELLS,
Dunn Geoscience Corp., Albany, NY.
For primary bibliographic entry see Field 8A.
W89-11947

SEEPAGE VELOCITIES IN STRESS-RELIEF FRACTURES IN THE EASTERN KENTUCKY COAL FIELD.
Law Environmental, Inc., Louisville, KY.
N. L. Songer, and R. O. Ewers.
IN: Proceedings of the FOCUS Conference on Eastern Regional Ground Water Issues, September 27-29, 1988, Stamford, Connecticut. National Water Well Association, Dublin, Ohio, 1988. p 565-583, 6 fig, 1 tab, 5 ref.

Descriptors: *Kentucky, *Coal mining, *Tracers, *Geohydrology, *Flow velocity, *Seepage, *Geologic fractures, *Stress, Wells, Groundwater movement, Springs, Dye releases.

Seepage velocities for stress-relief fractures, found in the hills and valleys of eastern Kentucky, were determined by performing fluorescent dye traces through selected fractures. A roadcut, which contained several fracture zones, was selected near Corbin, Kentucky, for five dye traces. The traces were run directly through the fractures using fluorescein, rhodamine WT, and direct yellow. Seepage velocities of 0.28 ft/hr and 0.55 ft/hr were determined with rhodamine WT and fluorescein, respectively. The direct yellow dye did not produce a positive result. Six wells, located within the Wolfpen Branch Basin, were selected near Hazard, Kentucky, for a large scale dye trace. Rhodamine WT was inserted into well no. 84. The remaining wells (nos. 50, 51, 80, 81, and 82), a spring, and a stream were monitored for the arrival of the dye. The dye was eventually detected in the shallow wells, nos. 81 and 82, as well as the spring and the stream sampling points. The dye was not detected in the deeper wells, nos. 50, 51, or 80. The dye trace produced seepage velocities of 0.67 ft/day and 1.38 ft/day. These values represent the velocity of groundwater movement within a basin containing stress-relief fractures. This encompasses flow through not only vertical and horizontal fractures, but flow along bedding plane breaks and confining beds are well. The determined seepage velocity values can be used to aid in the prediction of arrival times for contaminants released by mining processes. (See also W89-11916) (Author's abstract)
W89-11948

GEOCHEMISTRY OF RADON-RICH WATERS FROM TWO-MICA GRANITES.
New Hampshire Univ., Durham.
For primary bibliographic entry see Field 2K.
W89-11949

AERATION FOR THE REMOVAL OF RN FROM SMALL WATER SUPPLIES.
Lowry Engineering, Inc., Unity, ME.
For primary bibliographic entry see Field 5F.
W89-11950

HYDROGEOLOGIC AND SOIL GAS EVALUATION OF GROUNDWATER CONTAMINATION AT A MUNICIPAL LANDFILL IN NEW YORK STATE.
Dunn Geoscience Corp., Albany, NY.
For primary bibliographic entry see Field 5B.
W89-11951

DETECTION OF SUBSURFACE GASOLINE CONTAMINATION IN NEW ENGLAND GLA-

CIATED TERRAIN USING SOIL GAS SURVEYING.
Connecticut Univ., Storrs. Dept. of Geology and Geophysics.
For primary bibliographic entry see Field 5A.
W89-11952

CONCEPTUAL MODEL OF NUTRIENT TRANSPORT IN SUBSURFACE SOIL SYSTEMS,
Maine Univ. at Orono. Environmental Studies Center.
For primary bibliographic entry see Field 5B.
W89-11958

GROUNDWATER POLLUTION--PROBLEMS AND SOLUTIONS.
National Water Well Association, Worthington, OH.
For primary bibliographic entry see Field 5B.
W89-11963

NITRATE CONTAMINATION OF THE WATER-TABLE AQUIFER BY SEPTIC TANK SYSTEMS IN THE COASTAL PLAIN OF DELAWARE.
Delaware Geological Survey, Newark.
For primary bibliographic entry see Field 5B.
W89-11964

VIRUS MOVEMENT INTO GROUNDWATER FROM SEPTIC TANK SYSTEMS.
Maine Univ., Orono. Dept. of Civil Engineering.
For primary bibliographic entry see Field 5B.
W89-11965

HYDROGEOLOGIC MISINTERPRETATIONS AND AQUIFER CONTAMINATION CAUSED BY LEAKING MONITORING WELLS.
Brown (K.W.) and Associates, Inc., College Station, TX.
For primary bibliographic entry see Field 7A.
W89-12003

CONSTRUCTION AND QUALITY ASSESSMENT OF THE IN SITU CONTAINMENT OF CONTAMINATED GROUNDWATER.
GKN Hayward Baker Co., Odenton, MD.
For primary bibliographic entry see Field 5G.
W89-12004

CAPTURE OF A GROUNDWATER CONTAMINATION PLUME IN FRACTURED BEDROCK BY AN ARTIFICIALLY PRODUCED FRACTURE ZONE CREATED THROUGH CONTROLLED BLASTING.
Dunn Geoscience Corp., Albany, NY.
For primary bibliographic entry see Field 5G.
W89-12005

SIMULATION OF GROUNDWATER FLOW CHARACTERISTICS BY FLOW AND MASS TRANSPORT MODELS.
New Jersey Dept. of Environmental Protection, Trenton. Div. of Solid Waste Management.
For primary bibliographic entry see Field 5G.
W89-12006

ISOLATION AND MITIGATION OF GROUNDWATER CONTAMINATION BASED ON GROUNDWATER MODELING TECHNIQUES: A CASE HISTORY.
Camp, Dresser and McKee, Inc., Atlanta, GA.
For primary bibliographic entry see Field 5G.
W89-12007

CONTROL AND REMEDIATION OF VOLATILE ORGANIC CHEMICAL MIGRATION IN FRACTURED BEDROCK.
Jordan (Edward C.) Co., Inc., Portland, ME.
For primary bibliographic entry see Field 5B.
W89-12008

DESIGN AND OPERATIONAL CHARACTERISTICS OF A COLLECTION TREATMENT/RECHARGE/FLUSHING GROUNDWATER REMEDIATION SYSTEM.
PRC Environmental Management, Inc., Chicago, IL.
For primary bibliographic entry see Field 5G.
W89-12009

BASICS OF GROUNDWATER CONTAMINATION MODELING.
Camp, Dresser and McKee, Inc., Atlanta, GA.
For primary bibliographic entry see Field 5B.
W89-12011

STATISTICAL MODEL FOR DISTRIBUTION OF CHEMICALS IN GROUNDWATER,
Woodward-Clyde Consultants, Denver, CO.
For primary bibliographic entry see Field 5B.
W89-12059

MODELING OF CONTAMINANT TRANSPORT FROM RESERVE PIT SITES.
ERT, A Resource Engineering Co., Concord, MA.
For primary bibliographic entry see Field 5B.
W89-12067

RECHARGE STUDIES IN THE WESTERN MURRAY BASIN: 3. RESULTS OF DRILLING PROGRAMS AT EUSTON AND BALRANALD.
Commonwealth Scientific and Industrial Research Organization, Adelaide (Australia). Div. of Water Resources.
P. G. Cook, A. N. Holub, and G. R. Walker.
Technical Memorandum 98/1, March 1989. 31p, 15 fig, 12 tab, 4 ref.

Descriptors: *Groundwater recharge, *Drilling, *Groundwater quality, *Agriculture, *Vegetation effects, Australia, New South Wales, Eucalyptus trees, Salinity.

This report presents the results of drilling programs carried out between August and September 1988 at field sites near Euston and Balranald, western New South Wales. The aim of the project was to determine whether clearing of native mallee (Eucalyptus spp.) vegetation in the region is likely to lead to significant groundwater salinity problems. The holes are located beneath mallee, and on land which was cleared 50 years ago, and has since been used for pasture and crops under a dryland farming regime. Samples were analyzed for water content, chloride and matric suction. (See also W89-05757 and W89-05423)(Author's abstract)
W89-12077

ANALYSIS OF WATER-LEVEL FLUCTUATIONS IN WISCONSIN WELLS.
Geological Survey, Madison, WI. Water Resources Div.
G. L. Patterson, and A. Zaporozec.
Available from Books and Open-File Report Section, USGS, Box 25425, Denver, CO 80225. Information Circular 63, 1987. 38p, 10 fig, 15 tab, 15 ref.

Descriptors: *Water table fluctuations, *Water level fluctuations, *Wisconsin, *Wells, Groundwater level, Hydrographs, Well hydrographs, Seasonal variation, Geohydrology, Frequency analysis, Drought, Frequency distribution, Meteorology, Hydrologic systems, Geology, Precipitation, Groundwater budget, Statistical analysis, Geomorphology.

This report presents the results of statistical analyses of historical groundwater level fluctuations in Wisconsin. Short-term and long-term fluctuations are discussed in terms of their relation to components of the geohydrologic system. Water level measurements from 124 wells with at least 20 years of record each were used in the study. Hydrographs of average annual water level and frequency distribution analyses of annual maximum and minimum water levels were inspected for possible long-term trends. Analysis of annual maximum and minimum water levels indicates several periods in the annual cyclic fluctuations--two periods of recession (winter and summer), and two periods of rising levels (spring and fall). Usually, water levels are lowest in late winter and highest in spring for every annual cycle. A composite frequency analysis of extreme annual water levels on 71 of the wells shows that the lowest levels most frequently occur in December, February, or March. However, the record low usually occurs in August, September, or October during drought. Groundwater levels most often peak in May, April, or June. In the fall they may peak from September through December, depending upon complexities of meteorological, geomorphological, and geological factors. The hydrographs show several periods of well-defined peaks and lows. The groundwater levels reached peaks in 1946, 1952, 1960, 1966, 1973, 1979. The average interval between these peaks is 6.6 years. The low levels occurred in 1949, 1958-59, 1964, 1970, and 1977; average interval between the low levels is 7.0 years, which is similar to that for the high levels. The trend of average annual water levels has been generally increasing since the late 1950's and is in general agreement with the increasing trend of precipitation. (Lantz-PTT)
W89-12136

2G. Water In Soils

MICROBIAL TRANSFORMATIONS OF AZAARENES IN CREOSOTE-CONTAMINATED SOIL AND GROUND WATER: LABORATORY AND FIELD STUDIES.
Geological Survey, Denver, CO.
For primary bibliographic entry see Field 5B.
W89-11072

MICROBIAL ECOSYSTEM IN PETROLEUM WASTE LAND TREATMENT,
University of Southern California, Los Angeles. Environmental Engineering Program.
For primary bibliographic entry see Field 5D.
W89-11109

DEGRADATION OF ATRAZINE AND RELATED S-TRIAZINES.
Kansas State Univ., Manhattan. Dept. of Chemical Engineering.
For primary bibliographic entry see Field 5B.
W89-11197

DEGRADATION OF CHLORINATED AND NON-CHLORINATED AROMATIC SOLVENTS IN SOIL SUSPENSIONS BY PURE BACTERIAL CULTURES.
Groningen Rijksuniversiteit (Netherlands). Dept. of Biochemistry.
For primary bibliographic entry see Field 5G.
W89-11214

RELATIONSHIP OF CATCHMENT TOPOGRAPHY AND SOIL HYDRAULIC CHARACTERISTICS TO LAKE ALKALINITY IN THE NORTHEASTERN UNITED STATES,
Geological Survey, Trenton, NJ. Water Resources Div.
For primary bibliographic entry see Field 2K.
W89-11253

NITROGEN FIXATION AND NITROGEN ASSIMILATION IN A TEMPERATE SALINE ECOSYSTEM.
Dundee Univ. (Scotland). Dept. of Biological Sciences.
B. Wollenweber, and S. Zechmeister-Boltenstern.
Botanica Acta, Vol. 102, No. 1, p 96-105, February 1989. 2 fig, 10 tab, 66 ref.

Descriptors: *Nitrogen fixation, *Saline soils, *Soil environment, *Soil chemistry, Lakes, Ecosystems, Microbial degradation, Halophytes.

The relationship between soil microbial activity and the nitrogen assimilation of 5 different halophytes from 4 saline sites near the lake 'Neusiedlersee' (Australia) was investigated. Between May

and October 1985, the following were studied: (1) nitrogen fixation (15N2 and acetylene reduction), (2) N-mineralization, (3) several soil characteristics, and (4) in vivo nitrate reductase activity of roots and shoots of these plants. NO3(-), organic N and carboxylate contents of the roots and shoots, as well as the effect of NO3(-) fertilization on the amounts of these substances, were determined on plants growing in the field during a 3-day period in September 1985. Fertilization led to a decrease in acetylene reduction activity at most sites, and an increase in the nitrate reductase activity of the shoots of all plants. Overall, carboxylate and organic nitrogen contents of these halophytes did not change in response to fertilization. Only in the roots of Aster tripolium and Atriplex hastata was there a marked increase in the nitrate reductase activity in response to fertilization. Species growing at the same site, such as Plantago maritima and Lepidium crassifolium showed contrasting levels of assimilatory activity. Apparent low rates of ammonification and nitrification were detected in soils from the four sites. (Author's abstract)
W89-11397

HYDROGEOLOGY OF THE WESTERN PART OF THE SALT RIVER VALLEY AREA, MARICOPA COUNTY, ARIZONA.
Geological Survey, Tucson, AZ. Water Resources Div.
For primary bibliographic entry see Field 2F.
W89-11484

ANALYSIS OF SOIL WATER MOVEMENT ON A SANDY HILLSLOPE.
New Mexico Inst. of Mining and Technology, Socorro. Dept. of Geoscience.
J. T. McCord, and D. B. Stephens.
Available from National Technical Information Service, Springfield, VA 22161 as PB89-182885/AS, price codes: A09 in paper copy, A01 in microfiche. New Mexico Water Resources Research Institute, Las Cruces, Technical Completion Report, February 1989. 168p, 87 fig, 8 tab, 87 ref. USGS Contract 14-08-0001-G1130. State Project 1423660.

Descriptors: *Unsaturated flow, *Soil water movement, *Soil moisture meters, *Hysteresis, *Anisotropy, Soil water, Finite element method, Soil moisture deficiency, New Mexico, Infiltration, Simulation analysis.

Field experiments were conducted on a virtually unvegetated, thinly stratified sand dune near Socorro, New Mexico to determine whether soil moisture movement had significant horizontal flow components. The site is in a semi-arid area where mean annual precipitation is about 20 cm. The site was instrumented with tensiometers and neutron probe access tubes to monitor soil water movement. These instruments show that near unit vertical hydraulic gradients occur and that moisture from infiltrated precipitation propagates deep into the sand, except near the dune crest. A bromide tracer buried at different locations beneath the dune slope was found by core sampling to have moved a significant distance downslope from the source. It appears that soil moisture does exhibit horizontal flow components, even through the hydraulic gradients near vertical. A series of numerical simulations was conducted to identify the most likely explanation for the observed field behavior. The principal phenomena considered were: (1) hysteresis in the moisture characteristics curves which prolongs the retention of infiltrated water in a zone sloping nearly parallel to the dune slope; and (2) anisotropy which is either constant at all saturations or which increases with decreasing saturation. A finite element flow and transport code, VAM2D, was modified to account for hysteresis and state-dependent anisotropy. Input hydraulic properties were derived from extensive field and laboratory characterization. The soil moisture characteristic curve was highly hysteretic but the soil was only slightly anisotropic at saturation. Nevertheless, the simulation of rainfall infiltration showed that the field behavior is mostly attributed to state-dependent anisotropy. This finding tends to support recent theories on anisotropy of unsaturated soil. (USGS)
W89-11488

WATER RELATIONS AND GROWTH RESPONSES OF UNIOLA PANICULATA (SEA OATS) TO SOIL MOISTURE AND WATER-TABLE DEPTH.
Louisiana State Univ., Baton Rouge. Lab. for Wetland Soils and Sediments.
M. W. Hester, and I. A. Mendelssohn.
Oecologia OECOBX, Vol. 78, No. 3, p 289-296, March 1989. 3 fig, 3 tab, 29 ref. DNR Cooperative Agreement 21920-431C-79-06; Texaco Grant CE-82-54.

Descriptors: *Grasses, *Growth, *Soil-water-plant relationships, *Water table, *Soil water, Dunes, Waterlogging, Flooding, Leaves, Drought, Vascular tissues, Water stress.

This study examined the water relations and growth responses of Uniola paniculata (sea oats) to (1) three watering regimes and (2) four controlled water-table depths. This study demonstrated that excessive soil moisture resulting from inundation or shallow water-table depth has a greater negative effect on plant growth than do low soil moisture conditions. Waterlogging stress was observed in plants grown at 0.3 m above the water table. This stress was relieved, however, at an elevation of 0.9 m above the water table. As the elevation was increased from 0.9 to 2.7 m, there were no signs of drought stress nor a stimulation in growth due to lower soil moisture. It was concluded that although U. paniculata's moisture-conserving traits adapt it well to the dune environment, this species can grow very well at an elevation of only 0.9 m above the water table. Field measurements of water-table depth in three Louisiana populations averaged about 1.3 m. Therefore, the observed limited distribution of U. paniculata along the Louisiana coast apparently cannot be explained by waterlogging stress induced by the low dune elevations and the corresponding shallow water-table depth. (Author's abstract)
W89-11529

VEGETATION PATTERNS IN JAMES BAY COASTAL MARSHES: II. PHYSIOLOGICAL ADAPTATION TO SALT-INDUCED WATER STRESS IN THREE HALOPHYTIC GRAMINOIDS.
McMaster Univ., Hamilton (Ontario). Dept. of Biology.
For primary bibliographic entry see Field 2L.
W89-11565

TRANSPORT OF INORGANIC AND NATURAL ORGANIC TRACERS THROUGH AN ISOLATED PEDON IN A FOREST WATERSHED.
Oak Ridge National Lab., TN. Environmental Sciences Div.
P. M. Jardine, G. V. Wilson, R. J. Luxmoore, and J. F. McCarthy.
Soil Science Society of America Journal SSSJD4, Vol. 53, No. 2, p 317-323, March/April 1989. 9 fig, 2 tab, 23 ref.

Descriptors: *Solute transport, *Soil columns, *Forest soils, *Soil solution, *Soil water, *Tracers, *Forest watersheds, Inorganic compounds, Organic compounds, Pedons, Soil organic matter, Ions, Model studies, Mathematical equations, Convection, Dispersion.

The transport of several inorganic ions (Mg (2+), NH4(-), Br(-), and NO3(-)) and natural dissolved organic C (DOC) through the upper 1.2 m of an undisturbed soil block (pedon) isolated from the surrounding soil was investigated. The purpose of the study was to investigate the spatial heterogeneity and the rate of nutrient transport in a forest soil. The tracers were added as a pulse to the soil surface during saturated flow in three separate experiments sequentially involving MgBr2, NH4NO3, and DOC, respectively. The temporal patterns of NO3(-) and Br(-) concentration observed at selected profile locations in the pedon were described by the convective-dispersive (CD) equation using flux-type boundary conditions with effluent concentrations treat as flux-averaged concentrations. Skewed breakthrough curves (BTC) indicative of preferential flow were obtained at all measurement positions. Model-fitted velocities (v) agreed well with saturated infiltration rates established in-situ for soils of the adjacent forest watershed. Although the CD equation could describe the temporal mobility of the non-reactive Br(-) and NO3(-) tracers at any given point in the pedon, it could not adequately describe the tracer concentration profiles with depth at selected times after tracer addition. Observed BTCs for Mg(2+), NH4(+), and DOC indicated that these tracers were reactive with the soil but also demonstrated that a significant quantity of these tracers moved through the soil via preferential flow. The temporal patterns for reactive tracer movement through the pedon could be modeled with the CD equation when adsorption was reversible. (Author's abstract)
W89-11569

ESTIMATION OF UNSATURATED HYDRAULIC CONDUCTIVITY FROM FIELD SORPTIVITY MEASUREMENTS.
Commonwealth Scientific and Industrial Research Organization, Canberra (Australia). Div. of Environmental Mechanics.
I. White, and K. M. Perroux.
Soil Science Society of America Journal SSSJD4, Vol. 53, No. 2, p 324-329, March/April 1989. 4 fig, 4 tab, 24 ref. AWRAC Grant 84/157, National Soil Conservation Program Grant 87/12.

Descriptors: *Unsaturated flow, *Hydraulic conductivity, *Diffusivity, *Soil porosity, *Sorption, *Soil water, Model studies, Interstitial water, Capillary water, Soil water suction.

Measurement or estimation of the unsaturated hydraulic conductivity of soils, K(psi), is of central importance to the understanding of soil-water flows in many areas of hydrology and agriculture. Approximations are derived relating K(psi) to sorptivity, measured over a range of negative supply pressures. The approximations are tested against the Green-Ampt, Knight, and Broadbridge-White models of soil hydraulic properties. The lat model covers the range form a Green-Ampt like model to the weakly nonlinear Knight model. One fifth derived approximations is found to give K(psi) accurate to within 5 percent over the entire range of soil-water potential and the full range of the single Broadbridge-White model parameter. Comparison of estimates of K(psi) using this approximation with conventionally determined K(psi) for repacked and intact soil samples showed good agreement. In an application of the technique, measurements of sorptivity were used to identify the effect of rain, falling at the end of a severe drought, on K(psi) of the surface soil. These measurements were adapted to pinpoint the changes in characteristic pore size brought about by the rain. In addition, it is shown how the macroscopic capillary length of a soil may be estimated from sorptivity measurements at any supply pressure. One of the principal advantages of the technique is that measurements of sorptivity sample shallow soil depths. The technique, therefore, is suited to layered soils, shallow surface soils and soil tillage studies. (Author's abstract)
W89-11570

EFFECT OF ACCESS HOLE PROPERTIES ON SOIL WATER CONTENT DETERMINATION BY NEUTRON THERMALIZATION.
North Carolina State Univ., Raleigh. Dept. of Soil Science.
For primary bibliographic entry see Field 7B.
W89-11571

SIMPLE APPROXIMATE EQUATION TO CALCULATE DIFFUSIVITIES FROM ONE-STEP OUTFLOW EXPERIMENTS.
Agricultural Coll. of Athens (Greece). Lab. of Agricultural Hydraulics.
J. D. Valiantzas.
Soil Science Society of America Journal SSSJD4, Vol. 53, No. 2, p 342-349, March/April 1989. 11 fig, 15 ref.

Descriptors: *Mathematical studies, *Diffusivity, *Soil water, *Soil porosity, *Outflow, Mathemati-

cal equations, Numerical analysis, Hydrologic properties.

Gardner's approximation for determining soil water diffusivities (D(theta)), from one-step outflow experiments may deviate significantly from actual D(theta) values. By the systematic analysis of a weighting function that corrects the Gardner's solution, a new simple and accurate equation is derived. Numerical outflow experiments were performed for a variety of arbitrary D(theta) functions to demonstrate the validity of the equation. Results indicate that the suggested procedure is applicable even for nonlinear ln (D(theta)) functions and is more accurate than other previous methods. The present equation has been applied to analyze one-step outflow experiments in two soils. Numerical predictions of the outflow volumes were in good agreement with laboratory measurements. (Author's abstract)
W89-11572

EFFECT OF LOW ELECTROLYTE CONCENTRATION ON HYDRAULIC CONDUCTIVITY OF CLAY-SAND-HYDROXY POLYMERS SYSTEMS.
Volcani Inst. of Agricultural Research, Bet-Dagan (Israel). Inst. of Soil and Water.
R. Keren, and M. J. Singer.
Soil Science Society of America Journal SSSJD4, Vol. 53, No. 2, p 349-355, March/April 1989. 9 fig, 13 ref.

Descriptors: *Soil types, *Soil chemistry, *Soil water, *Groundwater movement, *Hydraulic conductivity, *Soil structure, *Electrolytes, *Soil physical properties, Soil horizons, Polyelectrolytes, Iron, Aluminum, Heavy metals, Adsorption, Clays, Sand, Polymers.

Iron and Al oxides are ubiquitous in soils and have profound effects on soil structure. The objectives of this study were to (1) determine the effect of Fe or Al-polymers on saturated hydraulic conductivity (HC) of smectite-sand mixtures at different percentages of the clay cation exchange capacity (CEC) at different sodium adsorption ratios (SAR) and solution electrical conductance (EC), and (2) determine the reason for the observed effect. The HC of 5 percent smectite, 95 percent acid washed quartz sand (0.1 to 0.5 mm diam.) with and without polymer additions was determined by leaching with SAR 5, 10, or 20 and eC 500, 100, 50, 10, 5, 3, 2, 1 solutions, and distilled water (DW) at pH 7.5. The HC of clay leached with SAR 5 solution decreased with a reduction in solution concentration from 500 to 1 mol sub c/cu m, after which clay was leached from the system and HC increased. No clay was leached from the column in the presence of hydroxy-Al polymers in excess of 25 percent of clay CEC. Little HC reduction occurred at SAR 10 in the presence of hydroxy-Al polymers. At SAR 20, HC of the clay-sand mixtures decreased greatly, but no clay was observed in the leachate. Hydroxy-Fe polymers produced similar effects, but to a lesser extent. The presence of hydroxy-Fe polymers equivalent to 50 percent of CEC was insufficient to prevent clay dispersion and removal from the column when SAR 5 solution of 1 mol sub c /cu m was replaced by DW. At 100 percent of CEC, Fe prevented clay dispersion when leached with SAR 5, 10, and 20 solutions. Iron was not as effective as Al-polymers in preventing reduction of HC at SAR 10. The Al-polymers appeared to be more effective than the Fe-polymers because they bound clay particles into larger stable microaggregates than did the Fe polymers. A smaller percent of particles < 2 microns was measured in the Al-treated clay than the Fe-treated clay. Both treatments increased the size of stable microaggregates compared to the untreated clay. (Author's abstract)
W89-11573

INCUBATION STUDIES OF THE FATE OF ORGANIC NITROGEN IN SOILS AMENDED WITH ACTIVATED SLUDGE.
Volcani Inst. of Agricultural Research, Bet-Dagan (Israel). Inst. of Soil and Water.
For primary bibliographic entry see Field 5E.
W89-11574

PEDOGENIC CARBONATES IN A CALCIAQUOLL ASSOCIATED WITH A RECHARGE WETLAND.
Dow Chemical U.S.A., Midland, MI.
J. A. Knuteson, J. L. Richardson, D. D. Patterson, and L. Prunty.
Soil Science Society of America Journal SSSJD4, Vol. 53, No. 2, p 494-499, March/April 1989. 4 fig, 2 tab, 15 ref.

Descriptors: *Soil chemistry, *Wetlands, *Soil horizons, *Carbonates, *Soil water, *Groundwater recharge, *Geohydrology, *Calcium compounds, Hydraulic conductivity, Soil-water-plant relationships, North Dakota.

Calcic horizon formation was studied in an Aeric Calciaquoll (Bearden series) adjacent to an occasionally ponded Typic Argiaquoll (Lindaas series) on the Lake Agassiz Plain of eastern North Dakota. Carbonates in the Calciaquoll accumulated from groundwater additions. Soil water monitoring during a year with near-normal rainfall and temperatures showed that an upward soil water flux existed during a 13-wk period from late spring through midsummer. Unsaturated hydraulic conductivity (UHC) values indicated that the 2BC horizon controlled upward water flux in this soil. Upward water movement through this horizon during the 14-wk period was estimated to be 36 mm. In late summer, evapotranspirative demand far exceeded the UHC of the horizon. As the soil dried, UHC values were further reduced. Assuming time of soil formation of 4000 to 9000 yr and detrital carbonate mineral levels of 10 to 15 percent by weight, annual additions of calcium carbonate equivalent (CCE) to the calcic horizon range from 0.1 to 0.2 mol/sq m-yr in this soil, based on the amount of carbonate in the calcic horizon. Annual average levels of CCE in rising groundwater must be between 2.6 and 8.2 mmol/kg for the observed amount of carbonate to accumulate. The current amount of CCE in calcic horizon soil solution, as estimated by mathematically concentrating saturation past soluble ions to the observed constant water content, was 3.5 mmol/kg, a value within the range estimated. (Author's abstract)
W89-11575

SULFUR SPECIATION IN SOME CHESAPEAKE BAY TIDAL MARSH SOILS.
Maryland Univ., College Park. Dept. of Agronomy.
K. C. Haering, M. C. Rabenhorst, and D. S. Fanning.
Soil Science Society of America Journal SSSJD4, Vol. 53, No. 2, p 500-505, March/April 1989. 5 fig, 5 tab, 21 ref.

Descriptors: *Chemical speciation, *Water chemistry, *Marshes, *Tidal marshes, *Muck soils, *Soil chemistry, *Chesapeake Bay, *Soil profiles, *Sulfur, Pyrite, Iron, Estuaries, Sulfates, Soil classification.

In order to study S compounds and processes in Chesapeake Bay marshes, Sulfihemist profiles were sampled along a transect from inland to streamside marsh areas of Cedar Creek Marsh and in seven marshes along the Nanticoke River in Dorchester County, MD. In both areas, higher concentrations of pyrite were found in areas that received Fe inputs from tidal overwash or from diffusion from mineral layers within the profile. Pyrite accumulation was favored in streamside profiles that were subjected to frequent tidal flushing. Pyrite was the major form of S in most of the organic horizons of the Cedar Creek streamside pedons and in several of the Nanticoke pedons. Organic S was the major form of S in the Cedar Creek inland pedons. In both study areas, organic C was correlated with total S, apparently because of the S associated with organic materials and the ability of organic matter to hold sulfate-containing tidal water. High total S values were found to be indicators of areas of organic S accumulation. Pyrite content was not significantly correlated with total S or organic C. Identification of 'sulfidic materials' for purposes of soil classification should be based on analysis of pyrite S, as total S may be a poor estimate of oxidizable sulfides. (Author's abstract)
W89-11576

SOIL MACROPORE SIZE DISTRIBUTION FROM WATER BREAKTHROUGH CURVES.
Costa Rica Univ., San Jose. Dept. of Agricultural Engineering.
R. Radulovich, E. Solorzano, and P. Sollins.
Soil Science Society of America Journal SSSJD4, Vol. 53, No. 2, p 556-559, March/April 1989. 3 fig, 24 ref.

Descriptors: *Soil porosity, *Hydraulic properties, *Soil water, *Pore size, Pores, Distribution patterns, Mathematical studies, Costa Rica.

A new method for characterizing macropore size distribution is presented for a well-aggregated Oxic Dystropept at La Selva, Costa Rica, known to exhibit macropore flow. Samples were taken as undisturbed cores from a secondary forest and an abandoned pasture. The method is based on hydraulic principles, including the Poiseulle equation, and on water breakthrough curves obtained by timing and measuring water flow through the cores from a drained state (simulating field capacity) to a saturated steady-state flow condition. Application of the method to the La Selva soil (0 to 20-cm depth) yielded macropore radii between 50 and 200 microns, with a peak between 80 and 140 microns. The macropore size distributions calculated from moisture release curves to yield a set of complete pore size distributions. The method is simple, and the results are based on dynamic measurements, making them more applicable to flow models. (Author's abstract)
W89-11577

PREDICTING OIL INFILTRATION AND REDISTRIBUTION IN UNSATURATED SOILS.
Battelle Memorial Inst., Richland, WA. Pacific Northwest Labs.
For primary bibliographic entry see Field 5B.
W89-11578

GEOGRAPHICAL DISTRIBUTION OF SOIL MOISTURE IN THE SOUTHWESTERN PART OF JAPAN,
Yamagata Univ. (Japan). Faculty of General Education.
T. Aoyama.
Bulletin of Yamagata University, Natural Science YDKSAH, Vol. 12, No. 2, p 183-189, January 1989. 4 fig, 1 tab, 9 ref.

Descriptors: *Japan, *Soil water, *Meteorological data collection, *Climates, Wet climates, Distribution patterns, Arid climates, Monthly distribution, Seasonal variation, Hydrologic maps, Topography, Coasts, Basins, Vegetation, Land use.

The distribution of soil moisture in the southeastern part of Japan is discussed. Soil moisture was evaluated by means of bookkeeping procedures based on the Thornthwaite system. The meteorological data used in this study were obtained for a period of 16 years from 1967 to 1982 at 415 stations throughout the area. According to the concept of Russel's climatic years, the monthly values of soil moisture were annually elevated and summed up for the 16-year period to get the mean values of individual months. In the major part of southwestern Japan, the pattern of soil moisture content shows both wet and dry seasons. Soil is fully wet from February to April. A decrease of soil moisture begins in May and continues to December or January. The decrease and regional difference of soil moisture amount becomes particularly conspicuous from July through October. In August, soil moisture reaches the minimum amount in most places. Monthly distribution maps of soil moisture were presented for July through October. These maps reveal two types of dry regions influenced by topographic factors. One is a coastal region along the inland sea or bay, and the other is basin areas. The distribution maps of the soil moisture that were demonstrated in a series of reports by the present author may provide basic data for such studies as vegetation and land use. (Author's abstract)

W89-11587

SORPTION OF 2,3,7,8-TETRACHLORODIBENZO-P-DIOXIN FROM WATER BY SURFACE SOILS.
Maryland Univ., College Park. Dept. of Civil Engineering.
For primary bibliographic entry see Field 5B.
W89-11594

RELATIONSHIP BETWEEN SUBSURFACE BIODEGRADATION RATES AND MICROBIAL DENSITY.
Virginia Polytechnic Inst., Blacksburg. Dept. of Civil Engineering.
For primary bibliographic entry see Field 5B.
W89-11617

EVALUATION OF ELECTROMAGNETIC TOMOGRAPHY TO MAP IN SITU WATER IN HEATED WELDED TUFF.
Lawrence Livermore National Lab., CA.
For primary bibliographic entry see Field 7C.
W89-11752

GENERALIZED TWO-DIMENSIONAL ANALYTICAL SOLUTION FOR HYDRODYNAMIC DISPERSION IN BOUNDED MEDIA WITH THE FIRST-TYPE BOUNDARY CONDITION AT THE SOURCE,
International Technology Corp., Monroeville, PA.
For primary bibliographic entry see Field 5B.
W89-11755

WETTING FRONT INSTABILITY: 1. THEORETICAL DISCUSSION AND DIMENSIONAL ANALYSIS.
New York State Coll. of Agriculture and Life Sciences, Ithaca. Dept. of Agricultural and Biological Engineering.
R. J. Glass, J.-Y. Parlange, and T. S. Steenhuis.
Water Resources Research WRERAO, Vol. 25, No. 6, p 1187-1194, June 1989. 2 fig, 24 ref. EPA Grant R81-2919-01-0.

Descriptors: *Path of pollutants, *Underground waste disposal, *Unsaturated flow, *Soil water, *Infiltration, *Wetting front, Unstable systems, Dimensional analysis, Vadose water, Porous media, Groundwater movement, Mathematical studies, Stability analysis, Wetting.

Highly nonuniform moisture and solute transport in sandy soils has long been noted. A mechanism for nonuniform transport is an instability in the infiltration flow itself, or wetting front instability. When a wetting front becomes unstable, 'fingers' form and move down through the vadose zone to the phreatic surface, bypassing much of the unsaturated porous medium. A theoretical framework for wetting-front instability has been developed through classical dimensional analysis. Relationships between system parameters and initial/boundary conditions and unstable flow field behavior, as characterized by finger width and finger velocity, are derived. The scaling theory of Miller and Miller, published in 1956, is used to generalize these relationships to similar porous media with different mean grain sizes and show the effects of coarseness and fluid properties. Other formulations for finger width, derived through linear stability analysis, are examined to arrive at possible functional forms not yielded by dimensional analysis. (See also W89-11761) (Author's abstract)
W89-11760

WETTING FRONT INSTABILITY: 2. EXPERIMENTAL DETERMINATION OF RELATIONSHIPS BETWEEN SYSTEM PARAMETERS AND TWO-DIMENSIONAL UNSTABLE FLOW FIELD BEHAVIOR IN INITIALLY DRY POROUS MEDIA.
New York State Coll. of Agriculture and Life Sciences, Ithaca. Dept. of Agricultural and Biological Engineering.
R. J. Glass, T. S. Steenhuis, and J.-Y. Parlange.
Water Resources Research WRERAO, Vol. 25, No. 6, p 1195-1207, June 1989. 18 fig, 1 tab, 11 ref. EPA R81-2919-01-0.

Descriptors: *Path of pollutants, *Underground waste disposal, *Unsaturated flow, *Soil water, *Infiltration, *Wetting front, Soil physical properties, Particle size, Unstable systems, Dimensional analysis, Vadose water, Porous media, Groundwater movement, Mathematical studies, Stability analysis, Wetting.

The stability of a given vertical infiltration system is a function of the expected 'finger' width in two-dimensional systems (or diameter in three dimensions) calculated for the layer and the maximum horizontal width (or diameter) of the system. If the finger width is less than the width of the system, instability is expect, whereas for a finger width greater than or equal to the maximum system width, the system is stable. Dimensional analysis was used to guide experimental studies. When a wetting front passes from a fine-textured layer of initially dry sand into an underlying coarse layer, the front breaks into fingers. A specially developed vertical slablike chamber and associated techniques were developed for the study of such fingering. The flow rate through the system is systematically varied by using different mean grain size separates for the upper layer (the same coarse separate being used for the bottom layer). Relationships between finger width, propagation velocity, moisture content, and flow rate through individual fingers were determined experimentally and related to the properties of the bottom layer and the flow rate through the system. The results differed from those found in an earlier experimental study, which used different techniques for sample preparation. Results obtained here agreed with the formulation derived previously using linear stability analysis. (See also W89-11760) (Author's abstract)
W89-11761

PHYSICALLY BASED MODEL OF HETEROGENEOUS HILLSLOPES: 1. RUNOFF PRODUCTION,
Lancaster Univ. (England). Centre for Research on Environmental Systems.
For primary bibliographic entry see Field 2A.
W89-11763

PHYSICALLY BASED MODEL OF HETEROGENEOUS HILLSLOPES: 2. EFFECTIVE HYDRAULIC CONDUCTIVITIES,
Lancaster Univ. (England). Centre for Research on Environmental Systems.
For primary bibliographic entry see Field 2A.
W89-11764

MODELING ONE-DIMENSIONAL INFILTRATION INTO VERY DRY SOILS: 1. MODEL DEVELOPMENT AND EVALUATION.
New Mexico State Univ., Las Cruces. Dept. of Mechanical Engineering.
R. G. Hills, I. Porro, D. B. Hudson, and P. J. Wierenga.
Water Resources Research WRERAO, Vol. 25, No. 6, p 1259-1269, June 1989. 4 fig, 2 tab, 22 ref. USNRC Project TD-2049 and EPA Grant R811862-02-0.

Descriptors: *Infiltration, *Model studies, Dry soils, Supercomputers, Algorithms, Mathematical models, Computer models, Saturated flow, Soil water, Mathematical equations.

One of the more difficult water flow problems to model, from a numerical point of view, is infiltration into very dry soils. The presence of very steep pressure gradients combined with the large field scales leads to algorithms that are very central processing unit (CPU)-intensive. A water content-based algorithm has been developed that is suitable for modeling one-dimensional unsaturated flow into layered soils. It is shown that this algorithm is a numerical approximation of a general form of the Richards equation. The computational effects of this algorithm are compared with that of two pressure head (h)-based finite difference water flow algorithms using several test problems. The mass balance errors for the noniterative water content formulation are of the order of machine round-off error for most applications. For soils with fairly wet initial conditions (h approximately -100 cm H2O), the water content formulation requires approximately the same CPU time as the faster of the two pressure head formulations. For very dry soils (h = -1000 to -50,000 cm H2O), the CPU time required for the water content formulation is not a function of the initial water content of the soil, whereas the CPU time required for the pressure head formulation strongly increases with decreasing initial water content. Because of this lack of sensitivity to initial conditions, the water content-based algorithm is 1-3 orders of magnitude faster than the pressure head-based algorithms when applied to infiltration in very dry soils. The water content algorithm is not suitable for combined saturated-unsaturated or near-saturated flow, which may be present because of local heterogeneities in the soil. In addition, the water content-based algorithm cannot handle positive pressure upper boundary conditions such as those associated with ponded surface water. (See also W89-11768) (Author's abstract)
W89-11767

MODELING ONE-DIMENSIONAL INFILTRATION INTO VERY DRY SOILS: 2. ESTIMATION OF THE SOIL WATER PARAMETERS AND MODEL PREDICTIONS.
New Mexico State Univ., Las Cruces. Dept. of Mechanical Engineering.
R. G. Hills, D. B. Hudson, I. Porro, and P. J. Wierenga.
Water Resources Research WRERAO, Vol. 25, No. 6, p 1271-1282, June 1989. 10 fig, 2 tab, 45 ref. NRC Project TD-2049 and EPA Grant R-811862-02-0.

Descriptors: *Infiltration, *Model studies, Dry soils, Algorithms, Mathematical models, Computer models, Saturated flow, Soil water, Mathematical equations, Lysimeters, Performance evaluation.

Using a water content-based, one-dimensional finite difference algorithm developed previously, infiltration into a 6-m lysimeter column containing alternate layers of air-dried clay loam and sand was modeled. The van Genuchten equation was used to model the pressure head (h)-volumetric water content (theta) relationship and both Campbell's and Mualem's equations were used to model the hydraulic conductivity (K)-theta relationship. Several sets of model parameters were estimated using data generated from various combinations of laboratory drainage experiments, laboratory measurements of saturated hydraulic conductivity, lysimeter observations of initial conditions, and lysimeter observations of water redistribution. Predictions of infiltration based on field distribution gave the best agreement with the observed infiltration into the lysimeter. The use of Campbell's K-theta relationship resulted in closer agreement between the infiltration model predictions and the lysimeter observations than did the use of Mualem's K-theta equation. The results show that infiltration model predictions for a carefully controlled field-scale lysimeter are very sensitive to the field and laboratory techniques used to estimate the soil water parameters. (See also W89-11767) (Author's abstract)
W89-11768

PREDICTION OF PHOSPHATE TRANSPORT IN SMALL COLUMNS WITH AN APPROXIMATE SORPTION KINETICS MODEL.
Agricultural Univ., Wageningen (Netherlands). Dept. of Soil Science and Plant Nutrition.
For primary bibliographic entry see Field 5B.
W89-11775

APPROXIMATE SOLUTION FOR ONE-DIMENSIONAL ABSORPTION IN UNSATURATED POROUS MEDIA,
California Univ., Berkeley. Earth Sciences Div.
R. W. Zimmerman, and G. S. Bodvarsson.
Water Resources Research WRERAO, Vol. 25, No. 6, p 1422-1428, June 1989. 7 fig, 26 ref. U.S. DOE Contract DE-AC03-76SF00098.

Descriptors: *Nevada, *Porous media, *Infiltration, *Absorption, *Unsaturated flow, Mathematical analysis, Boundary layer method, Integral method, Yucca Mountain, Topopah Spring, Radioactive waste disposal, Volcanic tuff, Saturation profiles.

The 'boundary layer' or 'integral' method was used to derive a closed-form approximate solution for one-dimensional absorption of water in an unsaturated porous medium whose characteristic curves are of the van Genuchten type. In this approach an assumed saturation profile is substituted into the governing equation and integrated from the boundary out to the wetting front. This yields closed-form solutions for the front location and the instantaneous liquid flux of the boundary. The accuracy of this solution in predicting the flux, as determined by comparison with numerical solutions utilizing a Boltzmann-type transformation, is always within 15%, for any value of the initial saturation. As an example of the use of this approximate solution, saturation profiles were calculated for absorption into the Topopah Spring volcanic tuff at Yucca Mountain, Nevada, the site of the proposed nuclear waste repository. (Author's abstract)
W89-11781

SEEPAGE EXCLUSION PROBLEM FOR SLOPING CYLINDRICAL CAVITIES.
Commonwealth Scientific and Industrial Research Organization, Canberra (Australia). Div. of Environmental Mechanics.
J. R. Philip.
Water Resources Research WRERAO, Vol. 25, No. 6, p 1447-1448, June 1989. 2 ref.

Descriptors: *Infiltration, *Unsaturated flow, *Seepage, *Groundwater movement, *Mathematical analysis, *Unsaturated flow, Geometry, Sloping cylinders, Tunnels, Cavities, Porous media, Slopes.

Solutions of the seepage exclusion problem for sloping cylinders of arbitrary cross section are deduced from those of horizontal cylinders. The three-dimensional flow field around sloping cylinders may be specified by two scalar functions of two space coordinates. The liability of sloping cylinders to water entry from downward unsaturated seepage decreases as the inclination of the cylinder axis to the horizontal increases. (Author's abstract)
W89-11784

MATHEMATICAL ANALYSIS OF ARTIFICIAL RECHARGE FROM BASINS.
Colorado State Univ., Fort Collins.
For primary bibliographic entry see Field 4B.
W89-11803

DETECTION OF SUBSURFACE GASOLINE CONTAMINATION IN NEW ENGLAND GLACIATED TERRAIN USING SOIL GAS SURVEYING.
Connecticut Univ., Storrs. Dept. of Geology and Geophysics.
For primary bibliographic entry see Field 5A.
W89-11952

IMPROVED FIELD TECHNIQUES FOR HYDRAULIC PROPERTIES OF SOILS.
Wisconsin Univ., Madison. Dept. of Soil Science.
For primary bibliographic entry see Field 7B.
W89-11968

FIELD INVESTIGATION OF MACROFEATURES IN COMPACTED SOIL.
Brown (K.W.) and Associates, Inc., College Station, TX.
For primary bibliographic entry see Field 5B.
W89-12026

DESIGN AND CONSTRUCTION OF EFFECTIVE SOIL LINERS.
Brown (K.W.) and Associates, Inc., College Station, TX.
For primary bibliographic entry see Field 5G.
W89-12029

ORGANIC FLUID EFFECTS UPON BENTONITE.
Bentec, Ferndale, MI.
For primary bibliographic entry see Field 5G.
W89-12031

USE OF AN INSTRUMENTED CONE PENETROMETER IN MONITORING LAND DISPOSAL SITES.
Army Engineer Waterways Experiment Station, Vicksburg, MS.
For primary bibliographic entry see Field 5B.
W89-12060

APPLICATIONS OF FIELD HEADSPACE ANALYSIS AND SOIL GAS ANALYSIS USING AN ORGANIC VAPOR METER TO ASSIST IN IDENTIFYING LABORATORY SAMPLE LOCATIONS.
Storch Engineers, Florham Park, NJ.
For primary bibliographic entry see Field 5B.
W89-12061

ENHANCED VOLATILIZATION FOR REMOVAL OF HAZARDOUS WASTE FROM SOIL.
Midwest Water Resource, Inc., Charlotte, MI.
For primary bibliographic entry see Field 5G.
W89-12064

EVALUATIONS OF COLLAPSE SUSCEPTIBILITY IN ALLUVIAL FAN DEPOSITS-TOWAOC, CANAL, REACH 2, TOWAOC, COLORADO.
Bureau of Reclamation, Denver, CO. Div. of Research and Lab. Services.
For primary bibliographic entry see Field 2J.
W89-12138

2H. Lakes

ESTIMATION OF UNBALANCED BACTERIAL GROWTH IN INHIBITORY ENVIRONMENTS BY PHYSIOLOGICAL ASSESSMENT.
Kanazawa Univ. (Japan). Dept. of Chemical Engineering.
T. Chohji.
Water Science and Technology WSTED4, Vol. 20, No. 11/12, p 53-59, 1988. 6 fig, 8 ref.

Descriptors: *Aquatic environment, *Wastewater treatment, *Limnology, *Bacterial analysis, *Bacterial physiology, *Growth rates, Microorganisms, Bacteria, Temperature effects, Microenvironment, Adaptation, Estimating, Inhibition, Wastewater.

The kinetic response of bacterial growth to an inhibitor concentration and/or environmental temperature changes was investigated. Microorganisms have a physiological state that adapts to a given environment, and they need a process to transfer to a new physiological state when the environmental condition changes. As an index of the physiological state, the cellular mass at the time of the initiation of the deoxyribonucleic acid (DNA) replication was chosen. From this viewpoint, a simple relation between the unbalanced growth behavior and the physiological state is proposed to be able to describe unbalanced growth under inhibitory and temperature changes. Applying this relation and using ethanol as an inhibitor, the calculated values of unbalanced growth after changes of ethanol concentration and/or temperature could simulate the experimental data with high accuracy. This method might also be applicable for forecasting profiles of unbalanced growth in environmental water or wastewater, which contains complex or unknown materials. (Author's abstract)
W89-11077

KINETICS OF ACETATE AND METHANOL CONVERSION INTO METHANE IN EUTROPHIC SEDIMENTS AND ITS APPLICATION IN ANAEROBIC SYSTEMS.
Max-Planck-Inst. fuer Limnologie zu Ploen (Germany, F.R.). Abt. Mikrobenoekologie.
M. Naguib.
Water Science and Technology WSTED4, Vol. 20, No. 11/12, p 61-67, 1988. 3 fig, 30 ref.

Descriptors: *Acetates, *Methane, *Eutrophication, *Limnology, *Methanol, *Anaerobic conditions, Soil chemistry, Wastewater treatment, Kinetics, Physicochemical properties, *Sediments, Chemical properties, Chemical reactions.

The production of methane by sediments amended with acetate and methanol with and without peptone can be described by the Michaelis-Menten kinetics. The Lineweaver-Burk reciprocal plots reveal, in analogy to the kinetics of enzyme reactions, a clearly defined pattern. Acetate underlies a competitive behavior with different Km values of 7 and 2 micromolar in the absence and presence of peptone, however, with a common maximum reaction rate (Vmax) of 0.3 micromoles CH4/g wet wt/d. Methanol shows, to the contrary, a non-competitive pattern with a common Km of 16.5 micromolar and different Vmax values of 0.2 and 0.5 micromoles in aged and fresh sediments that both increased to a common Vmax of 0.8 in the presence of peptone. The acetate pool in eutrophic sediments lies far below the determined Km values and hence acetate as such is restrictively available to methanogens. The stimulation of sediment methanogenesis amended with acetate through stimulants like peptone aims to lower the Km values and hence render methanogens a more favorable competitive potential. Stimulation of methanol methanogenesis is reflected in the increase in the Vmax with no influence on the Km values. Knowledge and proper application of determined kinetic parameters in anaerobic systems, e.g. in sewage treatment anaerobic towers, proved to be useful in manipulating an increased biodegradability and biogas production. (Author's abstract)
W89-11078

DISSIMILATIVE IRON REDUCTION BY THE MARINE EUBACTERIUM ALTEROMONAS PUTREFACIENS STRAIN 200.
California Inst. of Tech., Pasadena. W.M. Keck Engineering Lab. of Hydraulics and Water Resources.
For primary bibliographic entry see Field 2K.
W89-11079

BIOCHEMICAL METHODS FOR AUTOMATED BACTERIAL IDENTIFICATION AND TESTING METABOLIC ACTIVITIES IN WATER AND WASTEWATER.
Technische Univ. Berlin (Germany, F.R.). Dept. of Hygiene.
For primary bibliographic entry see Field 7B.
W89-11100

MICROBIAL COLONIZATION OF A SMOOTH SUBSTRATUM: A KINETIC ANALYSIS USING IMAGE ANALYSIS.
Montana State Univ., Bozeman. Inst. for Biological and Chemical Process Analysis.
A. R. Escher, and W. G. Characklis.
Water Science and Technology WSTED4, Vol. 20, No. 11/12, p 277-283, 1988. 6 fig, 3 ref. NSF Grant CBT-842078, Office of Naval Research Grant N00014-84-0309.

Descriptors: *Colonization, *Biofilms, *Image analysis, *Microscopic analysis, *Growth kinetics, *Microorganisms, Growth, Adsorption, Model studies, Growth rates, Substrates, Growth media, Diffusion, Advection, Desorption, Growth chambers.

A new technique for the measurement of early colonization of a smooth substratum is developed. Four initial events of biofilm colonization expressed in terms of colony forming cells (CFU), diffusive or advective transport processes, adsorption, desorption, and CFU separation are translated in terms of cells by determining the number of cells in each CFU. Two additional processes, multiplication and CFU erosion, are defined when cells,

not CFU, is the variable. In laminar flow experiments, microbial cells were grown in a chemostat and continuously flowed through a rectangular glass capillary. A single binary image of the specimen was stored on computer disk for analysis. The key parameter used in the conceptual model of colonization was the probability of an event within the total population. A dimensionless substratum particle capture factor is used to describe the interaction of the cells with the substratum during the process of adsorption. Results based on 15 experiments, 9 at 0.5 N/sq m and two each at 0.75, 1.0, and 1.25 N/sq m CFU concentration in the bulk flow of the capillary tube showed that behavioral characteristics of the organisms at the substratum, such as growth, rate and direction of motion, orientation, and more, can be measured accurately in situ. Sorption related processes depend on shear stress and bulk CFU concentrations, while growth related processes depend on the cell concentration at the substratum alone; although growth related processes are dominant within a short time, the extent of accumulation depends heavily on adsorption processes. (Friedmann-PTT)
W89-11108

UNIFIED THEORY FOR MICROBIAL GROWTH CONTROLLED BY MULTIPLE LIMITING SUBSTANCES,
Nanyang Technological Inst., Singapore. School of Civil and Structural Engineering.
For primary bibliographic entry see Field 5D.
W89-11150

LIMNOLOGICAL PROPERTIES OF A ROCKY MOUNTAIN HEADWATER RESERVOIR.
Wyoming Univ., Laramie. Dept. of Zoology and Physiology.
M. D. Marcus.
Water Resources Bulletin WARBAQ, Vol. 25, No. 1, p 15-25, February 1989. 4 fig, 3 tab, 40 ref. U.S. Department of Interior, Office of Water Research and Technology grant 14-34-0001-6207, Wyoming Water Research Center grant 5-38669.

Descriptors: *Headwaters, *Reservoirs, *Mountain lakes, *Limnology, *Nutrients, *Flow pattern, *Water circulation, Suspended sediments, Thermal stratification, Dissolved oxygen, Phosphorus, Nitrogen, Nitrogen fixation, Aphanizomenon, Chlorophyll a, Photosynthesis, Primary productivity, Hyalite Reservoir, Montana, Rocky Mountains, Mesotrophic lakes.

Hyalite Reservoir, Montana, was studied to determine properties of this small, montane, headwater, deep-release reservoir relative to reservoirs at lower elevations. While retention times for waters were as brief as 12 d, the mean residency of 40 d from mid-March to mid-December was within the range reported for other reservoirs. No significant through-reservoir gradients for suspended sediments were observed, contrasting to observations for most reservoirs. Thermal stratification, evident during the first part of the summer, was disrupted in August by cool, dense tributary inflows and strong wind-induced mixing. Dissolved oxygen concentrations paralleled temperature patterns in the reservoir; lowest average values for both occurred in waters sampled nearest the outlet. Total P averaged greater than twice the total N concentrations; greatest average concentrations for both were found in the near-bottom waters nearest the outlet. Enrichment of N concentrations in outflow over inflow waters is hypothesized to occur through N fixation by Aphanizomenon flos-aquae. Despite the relatively high quality of waters from tributary inflows, an algal bloom, chlorophyll a concentrations, and primary productivity estimates suggested that the reservoir was mesotrophic. Circulation of waters within the reservoir was primarily influenced by wind-induced mixing, thermal gradients, and currents produced by the deep-water outlet. (Author's abstract)
W89-11157

RHIZOSPHERE ECOLOGY OF SUBMERSED MACROPHYTES,
Army Engineer Waterways Experiment Station, Vicksburg, MS. Environmental Lab.
D. Gunnison, and J. W. Barko.
Water Resources Bulletin WARBAQ, Vol. 25, No. 1, p 193-201, February 1989. 105 ref.

Descriptors: *Submerged plants, *Plant growth substances, *Rhizosphere, *Aquatic bacteria, *Nitrogen fixing bacteria, *Roots, *Aquatic weed control, Nutrients.

Several aspects of the rhizosphere ecology of submerged macrophytes are reviewed including: the role of the rhizosphere microflora in affecting plant growth through influences on nutrient availability and production of plant growth regulating compounds. Interactions between components of the sediment microflora and plant roots are considered in relation to plant nutrition and growth. Possible applications of this information to the management of submerged macrophytes are considered. These applications all involve the use of native microorganisms, rather than the introduction of foreign and/or genetically engineered species. Altering the rhizosphere environment to produce conditions unsuitable for growth of nitrogen-fixing bacteria might reduce the growth of invasive species having a high nitrogen demand. This might be accomplished through the dissemination of a non-nitrogen fixing competing bacterium in sediment susceptible to invasion by the pest plant. The bacterium would colonize the available sites on the host plant root, leaving little or no colonizable area for the nitrogen-fixing bacteria. The same strategy might apply to the process of deamination. Other possible strategies involve the application to the sediment of organic matter containing allelopathic substances or other substances to inhibit the growth of nuisance macrophytes, methods to inhibit the proliferation of plant growth-promoting rhizobacteria or promote the growth of antagonistic rhizosphere microorganisms, or management of the rhizosphere environment to selectively increase the competitiveness of desirable macrophyte species. (Sand-PTT)
W89-11176

SUBMERSIBLE STUDIES OF CURRENT-MODIFIED BOTTOM TOPOGRAPHY IN LAKE SUPERIOR.
Lamont-Doherty Geological Observatory, Palisades, NY.
R. D. Flood.
Journal of Great Lakes Research JGLRDE, Vol. 15, No. 1, p 3-14, 1989. 7 fig, 30 ref. NSF grants OCE 85-01841 and OCE 87-10048.

Descriptors: *Limnology, *Lake sediments, *Lake Superior, *Bottom sediments, *Sedimentary structures, *Water currents, *Erosion, Submarines, Furrows, Arcuate depressions, Ripple marks, Clays, Sonar, Great Lakes.

Submersible studies of deep-lake sedimentary features, especially furrows (at 100 m depth) and large arcuate depressions (at 240 m depth), in an area directly north of the Keweenaw Peninsula, Lake Superior, have shown that currents deep in the lake are important agents in depositing and eroding sediments and in creating surficial sediment variability. Furrows are linear, parallel troughs created by flow-sediment interactions, and these bedforms are commonly observed in estuaries and in the deep sea. Sedimentological and isotopic studies show that sediment accumulation rates vary by 60-80% across the furrow profile (lower accumulation rates in the trough). Strong currents sweep the bottom at 100 m depth during the fall, winter, and spring when the lake is poorly stratified. These currents are strong enough to erode the furrowed sediments. Large arcuate depressions (about 5 m deep, 50 m wide, and 300 m long) are eroded into varved, carbonate-rich gray glacial clays in the deep lake floor. Ripples, developed on the trough walls, suggest that deep currents are occasionally strong enough to rework sediments at 240 m. Also, carbonate in the varved gray clays exposed on the walls and floor of the depressions may be dissolved by the undersaturated lake waters, leading to enhanced erosion. Both furrows and arcuate depressions have been observed in other Great Lakes. (Author's abstract)
W89-11181

SURFACE AND BENTHIC NEPHELOID LAYERS IN THE WESTERN ARM OF LAKE SUPERIOR, 1983.
Duke Univ., Beaufort, NC. Marine Lab.
B. M. Halfman, and T. C. Johnson.
Journal of Great Lakes Research JGLRDE, Vol. 15, No. 1, p 15-25, 1989. 10 fig, 32 ref. EPA grant 810274-0.

Descriptors: *Density currents, *Limnology, *Lake sediments, *Suspended sediments, *Thermal stratification, *Turbidity, Submarines, Lake Superior, Great Lakes.

Suspended sediment concentrations and thermal structure of the water column were measured in the western arm of lake Superior on 19 occasions in the ice-free season (May to October) of 1983. A surface turbidity plume was well developed in the spring, subsided in early summer, and was briefly reinforced by a storm in early July. A benthic nepheloid (cloudy) layer developed and persisted throughout the period of thermal stratification. This layer was supplemented by sediment introduced by density flows and local resuspension. Although the benthic nepheloid layer was well developed and an easily mappable feature, its contribution to the annual budget of the western arm was far less than that from spring runoff. (Author's abstract)
W89-11182

SEDIMENT REWORKING AND TRANSPORT IN EASTERN LAKE SUPERIOR: IN SITU RARE EARTH ELEMENT TRACER STUDIES.
Wisconsin Univ.-Milwaukee. Center for Great Lakes Studies.
J. R. Krezoski.
Journal of Great Lakes Research JGLRDE, Vol. 15, No. 1, p 26-33, 1989. 5 fig, 2 tab, 26 ref. EPA grant CR813538-01-0, University of Wisconsin Sea Grant Program (R/MW-38-PD).

Descriptors: *Limnology, *Lake sediments, *Bottom sediments, *Lake Superior, *Sediment-water interfaces, *Sediment transport, *Tracers, Rare earth elements, Samarium oxide, Neutron activation analysis, Spectroscopy, Submarines, Great Lakes.

A rare earth element (REE) tracer pellet was deployed at the floor of the Ile Parisienne basin of eastern Lake Superior to measure representative sediment reworking and transport processes in the benthic boundary layer of the profundal Great Lakes. Samarium oxide, a high neutron-capture cross-section REE, was added at a concentration 30,000 times greater than found naturally in the lake sediments. After 23 days the study site was reoccupied and 11 submersible-taken punch cores were collected from within and around the labeled area. Vertical core sections were then examined by instrumental neutron activation analysis. High resolution gamma spectroscopy of the labeled sediments revealed that little bioturbation had occurred during the 3.3-week period but that lateral advective transport processes moved tracer particles to the west and north at an average rate of 0.17 cm/s, although only 1% of the samarium deployed could be accounted for. These results demonstrate the utility of in situ tracer studies at profundal depths and suggest that longer-term studies will permit accurate measurement of post-depositional redistribution processes at the sediment-water interface of freshwater and marine environments. (Author's abstract)
W89-11183

SUBMERSIBLE-DEFLOYED VIDEO SEDIMENT-PROFILE CAMERA SYSTEM FOR BENTHIC STUDIES.
Wisconsin Univ.-Milwaukee. Center for Great Lakes Studies.
For primary bibliographic entry see Field 7B.
W89-11184

GEOCHEMICAL PARTITIONING OF PB, ZN, CU, FE, AND MN ACROSS THE SEDIMENT-WATER INTERFACE IN LARGE LAKES.

Michigan State Univ., East Lansing. Dept. of Geological Sciences.
For primary bibliographic entry see Field 2K.
W89-11185

GEOCHEMISTRY OF RARE EARTH ELEMENTS IN BENTHIC LAYER PARTICULATE MATTER AND SEDIMENTS OF LAKE SUPERIOR.
Michigan State Univ., East Lansing. Dept. of Geological Sciences.
For primary bibliographic entry see Field 2K.
W89-11186

PORE WATER PROFILES AND EARLY DIAGENESIS OF MN, CU, AND PB IN SEDIMENTS FROM LARGE LAKES.
Michigan State Univ., East Lansing. Dept. of Geological Sciences.
J. D. McKee, T. P. Wilson, D. T. Long, and R. M. Owen.
Journal of Great Lakes Research JGLRDE, Vol. 15, No. 1, p 68-83, 1989. 9 fig, 5 tab, 32 ref. NOAA Office of Sea Grant, grant NA86AA-D-SG043, EPA contract CR813535-01-1.

Descriptors: *Path of pollutants, *Limnology, *Lake sediments, *Bottom sediments, *Interstitial water, *Heavy metals, *Diagenesis, *Geochemistry, Manganese, Copper, Lead, Decomposing organic matter, Lake Superior, Great Lakes.

Mn, Cu, and Pb were measured in pore waters at a site in the Caribou sub-basin, Lake Superior. The pore water profiles show evidence for the post-depositional mobility of the metals, consistent with interpretations made from sediment concentration profiles. The pore water and sediment concentration profiles of Mn appear to be diagenetically linked. Diagenetic modeling results indicate that the measured profiles are not in a steady-state relationship. The cause of the non-steady-state conditions is unclear but may be related to recent changes in sedimentation rates and in Mn oxidation rates. Flux estimates for Cu and Pb show that these metals could be diffusing from the sediment to overlying water. The decomposition of organic matter is suggested as a source for the metals. A significant amount of Cu and Pb brought to the sediment surface during sedimentation appears to be recycled to the pore waters. This suggests that concentration profiles of these metals in the sediment may not be reliable indicators of the timing and amounts of anthropogenic metal input in Lake Superior. (Author's abstract)
W89-11187

PCBS AND PAHS AS TRACERS OF PARTICULATE DYNAMICS IN LARGE LAKES.
Minnesota Univ., Minneapolis. Dept. of Civil and Mineral Engineering.
J. E. Baker, and S. J. Eisenreich.
Journal of Great Lakes Research JGLRDE, Vol. 15, No. 1, p 84-103, 1989. 10 fig, 3 tab, 40 ref. NOAA Office of Sea Grant, grant NA-85-AA-D-SG136.

Descriptors: *Environmental tracers, *Limnology, *Lakes, *Particulate matter, *Polycyclic aromatic hydrocarbons, *Polychlorinated biphenyls, *Path of pollutants, Water pollution, Lake sediments, Organic matter, Suspended solids, Submarines, Lake Superior, Great Lakes.

Internal cycling of particles within the water column of the Great Lakes results in spatial and temporal variability in concentrations of hydrophobic organic contaminants. Concentrations of organic carbon, 14 polycyclic aromatic hydrocarbons (PAHs), and 35 polychlorobiphenyl (PCBs) congeners were measured in particles collected in detailed vertical profiles of the atmosphere, water column, and sediments of Lake Superior to assess the dynamics of organic matter and particle transport in large lakes. A benthic nepheloid layer (BNL), a particle-rich zone extending up from the lake floor, was observed from a manned submersible during a NOAA National Underwater Research Program cruise on Lake Superior in 1986. This region contains large numbers of both living organisms and detritus, indicating that the BNL is supplied with significant quantities of reduced carbon from above. Patterns of organic contaminants associated with particles were examined by principal components analysis to determine the sources of particles to the BNL. Settling of surface water particles is the dominant source of solids containing PAHs and PCBs to the BNL during stratification, while resuspension of surficial sediments also contributes to BNL formation. Large vertical fluxes of organic-rich particles serve to rapidly transport hydrophobic organic contaminants to the benthic region. Once in the BNL, however, particulate organic matter is rapidly degraded and is largely not incorporated into underlying sediments. Rates of particulate organic matter utilization in the BNL are estimated to be orders of magnitude faster than corresponding rates in Lake Superior surficial sediments. Internal cycling of particles and organic matter significantly impacts the behavior and residence times of nutrients and contaminants in the water column of large lakes. (Author's abstract)
W89-11188

VARIATIONS IN SEDIMENT ACCUMULATION RATES AND THE FLUX OF LABILE ORGANIC MATTER IN EASTERN LAKE SUPERIOR BASINS.
Wisconsin Univ.-Milwaukee. Center for Great Lakes Studies.
J. V. Klump, R. Paddock, C. C. Remsen, S. Fitzgerald, and M. Boraas.
Journal of Great Lakes Research JGLRDE, Vol. 15, No. 1, p 104-122, 1989. 9 fig, 5 tab, 50 ref.

Descriptors: *Sedimentation rates, *Carbon cycle, *Nitrogen cycle, *Sediment transport, *Limnology, *Lake sediments, *Lake Superior, *Bottom sediments, *Organic matter, *Diagenesis, *Geochemistry, Organic carbon, Nitrogen, Ammonium, Bottom currents, Storms, Oxygen, Submarines, Great Lakes.

Benthic environments in Lake Superior are variable and dynamic. The complex topography and morphology of eastern Lake Superior results in a variety of depositional environments, from shallow coastal bays to deep profundal basins. Direct observations of bottom types and collection of sediments across the gradient in environments reveal benthic systems that range in sediment accumulation rates from about 1.7 mm per year to virtually zero net long-term accumulation. Diagenetic modeling of organic C and N under steady-state conditions indicates that 15-40% of the organic C and N deposited is recycled into the overlying water. This 'metabolizable' fraction has a residence time in the sediment column estimated to be 30-60 years for organic C and 15-30 years for N. Concentration gradients of total dissolved inorganic C, ammonium, and oxygen in sediment pore waters yield fluxes of remineralized C and N across the sediment-water interface consistent with diagenetically modeled fluxes. Spatial variability is sediment accumulation patterns, however, is great, particularly in the deep, steep relief basins in the open lake. Here, distances of a few kilometers can radically alter deposition patterns. Evidence of aperiodic bottom currents were observed in the deepest charted basin of the lake as extensive fields of sediment ripples over hard, compacted relic silt and clays. While no currents were observed in these summertime dives, it is assumed that storms during isothermal conditions generate sufficient bottom currents at depth to very effectively scour the bottom. Differences in sediment metabolism appear to be determined by the flux of labile organic matter to the bottom coupled to the physical processes of sedimentation, resuspension, and horizontal transport. (Author's abstract)
W89-11189

DISTRIBUTIONS OF MANGANESE, IRON, AND MANGANESE-OXIDIZING BACTERIA IN LAKE SUPERIOR SEDIMENTS OF DIFFERENT ORGANIC CARBON CONTENT.
Wisconsin Univ.-Milwaukee. Center for Great Lakes Studies.
L. L. Richardson, and K. H. Nealson.
Journal of Great Lakes Research JGLRDE, Vol. 15, No. 1, p 123-132, 1989. 5 fig, 1 tab, 17 ref.

Descriptors: *Limnology, *Lake sediments, *Iron, *Manganese, *Aquatic bacteria, *Lake Superior, *Organic carbon, Nitrogen, Oxygen, Diagenesis, Geochemistry, Submarines, Great Lakes.

Profiles of oxygen, soluble and particulate Mn and Fe, organic C and N were examined in Lake Superior sediment cores, along with the distribution and abundance of heterotrophic and Mn-oxidizing bacteria. Analyses were performed using cores collected with the submersible Johnson Sea-Link II. Three cores, exhibiting a range of organic C content, were collected from the deepest basin in Lake Superior and the north and south ends of the Caribou trough, and brought to the surface for immediate analysis. Minielectrode profiles of oxygen concentration of the three cores were carried out using a commercially available minielectrode apparatus. Oxygen depletion to less than 1% occurred within 4 cm of the surface for two of the cores, but not until approximately 15 cm for the core from the south basin of the trough. The cores exhibited very different profiles of soluble, as well as leachable, Mn and Fe, suggesting different degrees of remobilization of these metals in the sediments. Vertical profiles of viable bacteria and Mn-oxidizing bacteria showed that aerobic (and facultative aerobic) heterotrophic bacteria were present at the highest concentrations near the surface and decreased steadily with depth, while Mn-oxidizing bacteria were concentrated primarily at and above the oxic/anoxic interface. Soluble Mn in the pore waters, along with abundant organic C, appeared to enhance the presence of Mn-oxidizing bacteria, even below the oxic/anoxic interface. Profiles of solid-phase leachable Mn suggested a microbial role in Mn reprecipitation in these sediments. (Author's abstract)
W89-11190

RELATIVE VALUES OF OXYGEN, NITRATE, AND SULFATE TO TERMINAL MICROBIAL PROCESSES IN THE SEDIMENTS OF LAKE SUPERIOR.
Michigan State Univ., Hickory Corners. W.K. Kellogg Biological Station.
R. G. Carlton, G. S. Walker, M. J. Klug, and R. G. Wetzel.
Journal of Great Lakes Research JGLRDE, Vol. 15, No. 1, p 133-140, 1989. 6 fig, 2 tab, 22 ref. NSF grants BSR-8407189 and BSR-8407078.

Descriptors: *Biotransformation, *Microorganisms, *Limnology, *Lake sediments, *Respiration, *Nitrates, *Sulfates, *Lake Superior, *Carbon metabolism, *Denitrification, *Diagenesis, Geochemistry, Submarines, Great Lakes.

The vertical distributions of the terminal electron acceptors oxygen, nitrate, and sulfate, and the rates of associated microbial processes (aerobic respiration, denitrification, and sulfate reduction) were determined in sediment core samples retrieved from Lake Superior with the submersible Johnson Sea-Link II. Direct measurements with microelectrodes showed that the penetration depth of oxygen into the sediment was 8-24 mm, while the depth distribution of nitrate varied greatly among the sampled sites. Based on the process rate measurements, oxygen supported respiration accounted for at least 94% of the carbon metabolism in these sediments, with the remainder being processed largely through denitrification. Sulfate reduction was found to be an insignificant process. (Author's abstract)
W89-11191

METHANE OXIDATION IN LAKE SUPERIOR SEDIMENTS.
Wisconsin Univ.-Milwaukee. Center for Great Lakes Studies.
C. C. Remsen, E. C. Minnich, R. S. Stephens, L. Buchholz, and M. E. Lidstrom.
Journal of Great Lakes Research JGLRDE, Vol. 15, No. 1, p 141-146, 1989. 4 fig, 14 ref. NASA Interdisciplinary Research Program in Earth Science grant 2022-IRP-79.

Descriptors: *Limnology, *Lake sediments, *Lake Superior, *Methane, Oxidation, Carbon radioisotopes, Kinetics, Submarines, Great Lakes.

Methane profiles generated from Lake Superior sediment cores suggested that significant methane consumption occurs within these sediments. One organic-rich core showed steep gradients, with oxygen becoming undetectable within 15 mm of the surface. Samples were incubated with C14-methane and time points were assayed for carbon dioxide to measure methane consumption rates. A kinetic analysis suggested that methane was consumed with an apparent half-saturation constant (Km) of approximately 4.6 microM and a maximal rate (Vmax) of 0.7 micromol/L/h. This apparent Km value is comparable to results obtained with other freshwater lakes, but the Vmax value is two orders of magnitude lower. (Author's abstract)
W89-11192

IN SITU STUDIES OF ORGANISM-SEDIMENT RELATIONSHIPS IN THE CARIBOU ISLAND BASIN, LAKE SUPERIOR.
Wisconsin Univ.-Milwaukee. Dept. of Geological Sciences.
L. F. Boyer, and R. B. Whitlatch.
Journal of Great Lakes Research JGLRDE, Vol. 15, No. 1, p 147-155, 1989. 8 fig, 1 tab, 20 ref. Federal Grant NA 84AA-D-00065, Project R/MW-38-PD.

Descriptors: *Lake basins, *Limnology, *Lake sediments, *Bottom sediments, *Sediment-water interfaces, *Lake Superior, *Benthic fauna, Invertebrates, Amphipods, Oligochaetes, Nematodes, Ostracods, Sculpin, Clays, Manganese oxides, Iron oxides, Submarines, Great Lakes.

In 1986, using the submersible Johnson Sea-Link II, a permanent bottom station was established at 350 m in the Caribou Island basin in order to examine physical and biological contributions to general disturbance at the sediment-water interface, particle mixing, and to begin to quantify feeding rates of the macro-infaunal invertebrates. To provide background information on this study site, eight 255 sq cm box cores were collected for photographic and faunal analysis, and 19 subcores for X-radiography were collected to examine and record epifaunal and infaunal biogenic structure and physical sedimentary features. The infaunal community was dominated by amphipods, oligochaetes, nematodes, and ostracods. Average infaunal density approximated 4700/sq m, with 90% of the organisms appearing within 4 cm of the sediment-water interface. Core-section photography revealed layered, fine-grained sediments overlying post-glacial clays. Some cores contained laminae of Mn and Fe oxides. Several subcores contained distinct dish-like laminae, which were most likely relict biogenic features created by the deepwater sculpin (Myoxocephalus thompsoni). Biogenic structures produced by infaunal burrowers were small (approximately 1 mm diameter), and confined to the upper 3 cm of the sediment. Burrow frequency varied widely from core to core. However, subcores containing dish-shaped, high-density horizons had the fewest number of infaunal burrows. The observations suggest that much of the near-surface sediment-mixing activity at the Caribou basin site is likely due to demersal fish; during the dives only indirect evidence of physical disturbance of the sediment-interface was observed. (Author's abstract)
W89-11193

HABITAT SELECTION OF LENTIC LARVAL LAMPREYS: PRELIMINARY ANALYSIS BASED ON RESEARCH WITH A MANNED SUBMERSIBLE.
Michigan State Univ., East Lansing. Dept. of Zoology.
D. S. Lee, and J. G. Weise.
Journal of Great Lakes Research JGLRDE, Vol. 15, No. 1, p 156-163, 1989. 3 fig, 2 tab, 25 ref.

Descriptors: *Aquatic habitats, *Lentic environment, *Larval growth stage, *Submarines, *Limnology, *Lamprey, *Fish management, Fish control agents, Larvae, Lake Superior, Great Lakes.

The existence of lentic larval lamprey populations has been recognized since the late 1950s. Yet little research has been conducted on their depth distribution and the determinants of habitat selection. A calibrated electrosampler mounted on the submersible Johnson Sea-Link II was used in 1985 to quantitatively sample more than 1200 sq m of varying substrate in Batchawana Bay, Lake Superior, in tandem with a mark/recapture program. Of 5269 marked ammocetes released at depths >22 m and 1300 released at depths <10 m, none was recovered with the submersible near specific release points. However, 16 deep released individuals and 113 shallow released individuals were recovered during routine Bayer 73 treatments up to 3.5 km from initial release points. A cross-factor study to test the relative importance on habitat selection of substrate particle size distribution vs. acclimation below the thermocline was conducted in 1986. Neither substrate particle size distribution nor thermal acclimation seem to explain the general absence of ammocetes at depths >15 m. Gross lentic habitat selection may revolve around the nearshore distribution of food particles and the interdiction of the thermocline along the leading face of alluvial fans in Batchawana Bay. (Author's abstract)
W89-11194

ASSESSMENT OF LAKE TROUT SPAWNING HABITAT QUALITY IN CENTRAL LAKE HURON BY SUBMARINE.
National Fisheries Research Center-Great Lakes, Ann Arbor, MI.
For primary bibliographic entry see Field 8I.
W89-11195

BURBOT (LOTA LOTA) BIOGENIC SEDIMENTARY STRUCTURES IN LAKE SUPERIOR.
Wisconsin Univ.-Milwaukee. Center for Great Lakes Studies.
L. F. Boyer, R. A. Cooper, D. T. Long, and T. M. Askew.
Journal of Great Lakes Research JGLRDE, Vol. 15, No. 1, p 174-185, 1989. 10 fig, 1 tab, 34 ref. Federal Grant NA 84AA-D-00065, Project R/MW-38-PD.

Descriptors: *Limnology, *Lake Superior, *Bottom sediments, *Sedimentary structures, *Fish behavior, Burbot, Submarines, Burrows, Trenches, Lake Superior, Great Lakes, Lake sediments.

Direct observations of burbot (Lota lota), their biogenic structures and excavating behavior were made in July and August of 1985 and 1986 from the submersible Johnson Sea-Link II at depths from 140-366 m in Lake Superior. Video tapes were made of at least 14 burbots and 25 or more separate biogenic structures in three general sedimentary environments: (a) soft, clay-rich muds in the bottoms of the deep basins, (b) crescentic clay bank undercuts and slump blocks, and (c) swallow-nest-like burrows at the base, or within the walls of 1-2 m clay cliffs. The burbot ranged in size from 0.50-.75 m total length. Biogenic structures ranged in size and shape from 0.80-1.50 m long in the linear, multiple entry, trenches; from 2.5-4.0 m in the crescentic bank overhangs; and from 0.25-0.65 m diameter burrows in the cliff walls. The actual frequency of burbot and their spatial distribution in these deep basins remains unknown, as only one burbot at a time was observed in these settings. Burbot may be solitary in their social behavior when observed in the hypolimnitic zone. The observations suggest that burbot are present in many deep areas of the lake, and that they create distinct biogenic structures whose size and shape appear controlled by a combination of sediment type and bottom topography. Comparisons can be made with the behavior and structures ('pueblo villages') created by marine Gadidae and associated species on the continental shelf and slope off New England, such as the cusk (Brosme brosme) and the tilefish (Lopholatilus chamaeleonticeps). That the burbot create these shelters in diverse sediment types and bottom conditions strongly suggests evolutionary and ecological pressures may exist for this behavior, yet no large predators of the burbot exist on the lake. These structures may enhance the burbot 's fishing efficiency, especially in the case of the trench structures. (Author's abstract)
W89-11196

VERIFIABLE EVAPORATION MODELING ON THE LAURENTIAN GREAT LAKES.
National Oceanic and Atmospheric Administration, Ann Arbor, MI. Great Lakes Environmental Research Lab.
For primary bibliographic entry see Field 2D.
W89-11249

HYPOLIMNETIC MIXING IN A WEAKLY STRATIFIED LAKE.
Princeton Univ., NJ. Dept. of Civil Engineering and Operations Research.
A. A. Aldama, D. R. F. Harleman, and E. E. Adams.
Water Resources Research WRERAO, Vol. 25, No. 5, p 1014-1024, May 1989. 7 fig, 21 ref.

Descriptors: *Limnology, *Temperature gradient, *Hypolimnion, *Thermal stratification, *Mixing, *Lakes, Thermal properties, Eddies, Diffusivity, Physical properties, *Model studies, Turbulent flow, Epilimnion, Heat transfer.

The evolution of the thermal structure of a weakly stratified lake, located in Venezuela, is studied by applying a hydrothermal model as a tool to analyze the observed data. Particular attention is given to the quantification of the mixing energies involved in the redistribution of heat content in the epilimnion and in the hypolimnion. Hence, an analysis of the epilimnetic and hypolimnetic mixing dynamics is presented. A model, which includes an entrainment law based on the upper mixed layer concept and a temperature diffusion equation with a parameterized hypolimnetic turbulent diffusivity, was used in the hydrothermal analysis. As a result, expressions for epilimnetic (wind stirring and penetrative convection) and hypolimnetic mixing energies are obtained and it is concluded that for the lake under study, hypolimnetic mixing controls the local thermal structure and the overall heat transfer process. The parameterization of hyplimnetic diffusion works well in reproducing the observed heat content and thermal structure. (Friedmann-PTT)
W89-11268

HYDROLOGY OF A SMALL WET CATCHMENT.
Warrnambool Inst. of Advanced Education (Australia). Faculty of Applied Science and Technology.
For primary bibliographic entry see Field 2A.
W89-11285

PATTERNS OF HERPETOFAUNAL SPECIES RICHNESS: RELATION TO TEMPERATURE, PRECIPITATION, AND VARIANCE IN ELEVATION.
Texas A and M Univ., College Station. Dept. of Wildlife and Fisheries Sciences.
J. G. Owen.
Journal of Biogeography JBIODN, Vol. 16, No. 2, p 141-150, March 1989. 6 fig, 1 tab, 50 ref.

Descriptors: *Animal populations, *Aquatic environment, *Aquatic habitats, *Ecosystems, *Regression analysis, *Precipitation, *Species diversity, Reptiles, Amphibians, Frogs, Toads.

In Texas, the relationship between eight physical environmental factors and species richness of salamanders, frogs and toads, turtles, lizards and snakes was investigated by multiple regression methods. Variance in elevation was significant for each reptilian taxon and was relatively more important for lizards and snakes than for turtles. Mean annual precipitation was significant for each taxon but was a stronger predictor for salamanders, frogs and toads, and turtles than for lizards and snakes. Mean annual temperature range was used to test the climatic stability hypothesis of species richness. This variable was significant, with negative coefficients, for frogs and toads, turtles and lizards and was consistent with the stability hypothesis. Mean intermonthly variability of pre-

cipitation, also interpreted as a stability measure, had a positive and significant relationship to snakes and was contradictory to the stability hypothesis. Variation in turtle and lizard species richness was significant for maximum and minimum temperatures of record and their squared values, respectively. Overall, the climatic variability indices exhibited only weak control over herpetofaunal species density. Furthermore, their influence on the species richness hypotheses was complex. Support, non-support, and non-significance depended upon the particular combination of environmental factors and taxa under consideration. A basic conclusion of this work is that the climatic stability and intermediate disturbance hypotheses of species richness, as interpreted and tested in this study, often function in directions not concordant with theory and are not satisfactory as general explanations of biotic richness for these vertebrate groups. (Author's abstract)
W89-11294

DISTRIBUTIONAL ECOLOGY OF RED-CAPPED PLOVER, CHARADRIUS RUFICAPILLUS (TEMMINCK, 1822), ON WESTERN AUSTRALIAN SALT LAKES.
Western Australia Univ., Nedlands. Dept. of Zoology.
M. Abensperg-Traun, and C. R. Dickman.
Journal of Biogeography JBIODN, Vol. 16, No. 2, p 151-157, March 1989. 5 fig, 2 tab, 46 ref.

Descriptors: *Ecology, *Australia, *Water birds, *Aquatic environment, *Salt flats, *Population dynamics, Food chains, Niches, Regression analysis, Biomass, Plovers, Aquatic habitats.

Red-capped plovers, Charadrius ruficapillus (Temminck, 1822), were counted by day during the breeding season in thirty plots along the shore of a salt lake in the southwest of Western Australia. Multiple regression analysis showed that food and habitat variables accounted for 63.4 percent of the total variation in bird numbers between plots, whereas principal components regression explained 59.2 percent of the variation. The major predictors of bird numbers were the width and slope of the shore and the orientation of the plots. These variables probably reflect the ease with which birds can exploit terrestrial prey such as ants, and aquatic prey such as dytiscid beetles, which constitute the principal food of C. ruficapillus. Bird numbers were correlated only weakly with the biomass of benthic invertebrates, probably because these prey are most active, and accessible, by night. Numbers of birds were accurately predicted by the multiple regression model at an additional six salt lakes in the southwest of Western Australia. It is suggested that regression models may be generally applicable in distributional studies of birds on salt lakes, and in predicting bird numbers in other comparably simple environments. (Author's abstract)
W89-11295

SEASONAL COMPARISON OF LEAF PROCESSING IN A TEXAS STREAM.
Southwest Texas State Univ., San Marcos. Aquatic Station.
R. A. Short, and S. L. Smith.
American Midland Naturalist AMNAAF, Vol. 121, No. 2, p 219-224, April 1989. 1 fig, 3 tab, 14 ref.

Descriptors: *Detritus, *Texas, *Macroinvertebrates, *Litter, Streams, Seasonal variation, Processing rates, Hackberry leaves.

The effects of temperature and the composition of the macroinvertebrate community on leaf litter processing were examined in a warmwater Texas stream by comparing processing rates during periods of maximum and minimum leaf fall. If a macroinvertebrate community composed of nontypical shredders adapted for the use of leaf litter did exist, then this community should be most prevalent on leaf packs during the autumn and winter when leaves are most abundant in the streambed. A seasonal comparison of the processing of hackberry (Celtis laevigata) leaves showed more rapid weight loss during the summer than during the winter. Processing coefficients (-k) of 0.124 (summer) and 0.074 (winter) were significantly different. The taxonomic and functional group compositions of the macroinvertebrates colonizing the packs were very similar with very few shredders present. When compared on a degree-day basis, there was not significant difference in processing rates between the two seasons. The lack of a change in the macroinvertebrate community and the results of the degree-day comparison indicate that temperature is the primary factor influencing processing rate in this stream. (Miller-PTT)
W89-11297

HABITAT-SPECIFIC PLASMID PATTERNS IN NATURAL BACTERIAL POPULATIONS OF FRESH-WATER LAKES.
Max-Planck-Inst. fuer Limnologie zu Ploen (Germany, F.R.). Abt. Mikrobenoekologie.
C. Schutt.
Internationale Vereinigung fur Theoretische und Angewandte Limnologie, Verhandlungen IVTLAP, Vol. 23, No. 4, p 1821-1824, December 1988. 2 fig, 8 ref.

Descriptors: *Limnology, *Aquatic bacteria, *Habitats, *Aquatic habitats, *Microorganisms, *Plasmids, Lakes, Dystrophic lakes, Alkaline lakes.

Plasmid patterns of typical bacterial isolates from two extreme limnic habitats--the dystrophic lake Frejen and soda lake Van Golu--were compared. Colony forming units (CFU) were reported between 600 and 1500 CFU/ml for lake Frejen and about 500 CFU/ml for lake Van Golu. Ninety-eight isolates from lake Frejen and fourty from soda lake Van Golu. A third of all isolates harbored plasmids. Plasmid patterns were uniform for each lake type. However, they differed very much from each other. Frejen isolates predominantly displayed plasmids of high molecular weight. Plasmid-bearing isolates from lake Van Golu displayed a different pattern of medium and small plasmids. Plasmid-bearing isolates from lake Frejen were members of Pseudomonas spp., Aeromonas spp., Acinetobacter spp., and Enterobacteriacea. Four isolates were of uncertain affiliation. Isolates of lake Van Golu were not identified. High numbers of plasmid-bearing isolates indicate an important role for an extended spectrum of physiological activities in both of the extreme habitats. The uniform plasmid patterns for each of the extreme habitats account for the existence of biotope-specific plasmid patterns. However, extreme environments usually generate specialized bacterial communities of reduced taxonomical spectra. In this case, plasmid patterns may be additionally taxa-specific. (Miller-PTT)
W89-11303

MECHANISM OF THE AEROBIC FE(III)-P SOLUBILIZATION AT THE SEDIMENT-WATER INTERFACE.
Lund Univ. (Sweden). Inst. of Limnology.
S. Fleischer, M. Bengtsson, and G. Johansson.
Internationale Vereinigung fur Theoretische und Angewandte Limnologie, Verhandlungen IVTLAP, Vol. 23, No. 4, p 1825-1829, December 1988. 3 fig, 14 ref.

Descriptors: *Cycling nutrients, *Nutrients, *Sediment-water interfaces, *Phosphorus, *Iron, *Solubility, Precipitation, Bacteria.

The fate of phosphorous at the sediment surface after precipitation with Fe(III) was studied by determining the solubilization of P from an Fe(III) precipitate of phosphate in a solution containing mineral salts. Glucose was studied by monitoring the soluble Fe and phosphate. It was found that the bacteria, Pseudomonas fluorescence, contained some of the phosphate at the start of the solubilization experiment. The changes of Fe and P concentrations in four experiments were then monitored 5-10 days. The experiments demonstrated that a growing culture of P. fluorescence is able to solubilize iron (III) precipitates under aerobic conditions with a simultaneous release of the bond phosphate into the solution. The solubilization does not occur because of a lower pH. This was shown by ny a calculation of the solubility product and by reference to the experiments in which the pH was adjusted repeatedly. Separate experiments with precipitates in medium which had not been in contact with any bacteria were also made and an equilibrium iron (III) content of 0.25 and 1.8 mg Fe/L was found at pH 3 and 2, respectively. (Miller-PTT)
W89-11304

BENTHIC BACTERIAL BIOMASS AND PRODUCTION IN A BLACKWATER RIVER.
Georgia Univ., Athens. Inst. of Ecology.
J. L. Meyer.
Internationale Vereinigung fur Theoretische und Angewandte Limnologie, Verhandlungen IVTLAP, Vol. 23, No. 4, p 1832-1838, December 1988. 3 fig, 1 tab, 28 ref. NSF grant BSR-8406631.

Descriptors: *Benthos, *Biomass, *Productivity, *Aquatic bacteria, *Georgia, Sediments, Trophic level, Invertebrates.

Bacterial biomass and production in the top 20 cm of the sediments of the Ogeechee River, a sixth order Coastal Plain river, were studied. The focus was on bacteria as a trophic resource in this river because Coastal Plain rivers generally have high rates of invertebrate secondary production, despite only moderate rates of primary production. Many of the invertebrates found in the sandy sediments are collector-gathers, which can assimilate sediment-associated bacteria. Bacterial biomass and productivity in Ogeechee River surface sediments varies with sediment organic matter content; however, average production in the top cm is $< 1\%$ of total organic matter input and mineralization rates. If there are significant amounts of bacterial biomass and production deeper in the sediments, then the contribution of bacteria to production and mineralization in this ecosystem would be greater than previously estimated. The productive bacterial community in the sandy sediments of the Ogeechee River extends at least 20 cm into the sediments and serves as a food resource for collector-gatherer invertebrates. Benthic bacterial biomass and production are correlated with sediment organic matter and increase allochthonous organic matter is deposited on the falling limb of floods. In streams with deep, well-aerated, sandy sediments, the hyporheic community extends far into the sediments and bacterial production in the hyporheos is probably an important trophic resource for the benthic community. In studies of stream ecosystems, these deep sediments cannot be ignored. (Miller-PTT)
W89-11305

MESOSCALE TEMPORAL VARIATION IN BACTERIAL STANDING CROP, PERCENT ACTIVE CELLS, PRODUCTIVITY AND OUTPUT IN A SALT-MARSH TIDAL RIVER.
Georgia Univ., Sapelo Island. Marine Inst.
S. Y. Newell, R. D. Fallon, B. F. Sherr, and E. B. Sherr.
Internationale Vereinigung fur Theoretische und Angewandte Limnologie, Verhandlungen IVTLAP, Vol. 23, No. 4, p 1839-1845, December 1988. 2 fig, 2 tab, 27 ref. NSF grant OCE 82-19866.

Descriptors: *Aquatic bacteria, *Rivers, *Productivity, *Tidal rivers, *Salt marshes, Temporal distribution, Standing crops, Seasonal variation.

A salt-marsh tidal river was repeatedly sampled at one standard point in the tidal cycle in both summer and winter, in order to try to determine whether diel, mesoscale and seasonal variations could be found for bacterial standing crop, activity and productivity. It has been proposed that a logistic model can be used to describe cycles of bacterial standing crop in coastal waters. The essence of this model is that bacterial nutrient supply and bacterivory alternately dominate in controlling standing crop. At peaks of bacterial crop, nutrient supply per cell would be limiting and per-cell bacterial activity would be low; the opposite would be true for valleys. For summer data, bacterial assemblage productivity was not related to the cycling of standing crop, and the percentage activity of the assemblage was low when total cell-numbers were high, may be a sign that logistic

cycling was occurring. Since both productivity and per cent activity were positively correlated with standing crop peaks in winter, there is probably a different set of controlling factors operative in winter than in summer. The fact that bacterial productivity was positively correlated with extent of tidal excursion into the marsh only in winter may indicate that other factors are overridden by marsh-interactive factors in winter. It may be that in summer, even inextensive tidal excursions onto the marsh yield large amounts of organics to bacteria, relative to bacterial ability to quickly exhaust them. (Miller-PTT)
W89-11306

STRUCTURE OF BACTERIAL COMMUNITIES IN A CENTRAL EUROPEAN OPEN GRASSLAND STREAM, THE BREITENBACH,
Max-Planck-Inst. fuer Limnologie, Schlitz (Germany, F.R.). Limnologische Flussstation.
J. Marxsen, and K. Moaledj.
Internationale Vereinigung fur Theoretische und Angewandte Limnologie, Verhandlungen IVTLAP, Vol. 23, No. 4, p 1855-1860, December 1988. 2 fig, 2 tab, 20 ref.

Descriptors: *Streams, *Europe, *Bacterial analysis, Numerical analysis, Mathematical studies, Grassland streams.

As part of the bacteriological investigations on the Breitenbach stream (Central Europe), strains were isolated from different sites along the brook to obtain a first impression of the bacterial community composition. For comparison, strains were also taken from the surrounding meadow soil. Physiological-biochemical features were determined by the rapid microtechniques established by Moaledj. These data, together with colony and cell morphological features, were used for numerical taxonomic analysis. One-hundred-thirty-seven strains were examined for 72 colony and cell morphological features by conventional techniques, and 145 physiological-biochemical features by rapid microtechniques. Data analysis was performed by calculating the simple matching coefficient for each pair of strains, including all positive and negative characters. A sorted similarity matrix was then constructed by complete linkage clustering. Distinct differences between the investigated locations are revealed, despite the use of one medium for the isolation of all cultures. The main differences can be regarded as typical, even though only a rather small number of strains from each location could be considered. However, this investigation is representative of that particular sampling occasion. The rather high number of strains from other locations, is particularly striking. It seems rather unlikely that stream water bacteria develop in the flowing water itself. There is presumably continuous replenishment especially from the sediment, but perhaps also from the surrounding meadows. However, clear differences between the sediment and water populations of the Dunbar, a small Canadian woodland stream have been reported previously. Cell seeding is particularly distinct under high water conditions, but should also be clearly recognizable during low water. It is possible that the stream water community is supplied with bacteria from location which are not represented, such as epilithic or epiphytic. Alternatively only a rather small fraction of the higher number of bacterial cells in the sediment enters the flowing water and is not represented by the rather few sediment isolates. (Miller-PTT)
W89-11308

METABOLIC COUPLING BETWEEN HETEROTROPHIC AND METHANOGENIC BACTERIA IN A RUNNING WATER FOOD CHAIN.
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Internationale Vereinigung fur Theoretische und Angewandte Limnologie, Verhandlungen IVTLAP, Vol. 23, No. 4, p 1861-1864, December 1988. 2 fig, 1 tab, 10 ref.

Descriptors: *Eutrophic streams, *Running waters, *Food chains, *Bacterial physiology, Methane bacteria, Heterotrophic bacteria, Metabolic coupling, Stream biota, Physiological ecology.

In the presence of sulfate or nitrate, the food web of fermenting bacteria is drastically altered. A special feature of the well-known interspecies H2 transfer is that the methanogens can cause hydrogenogens to produce more H2 than they would produce in pure culture, a real synoptic relation. Tracer experiments in the River Saar sediments revealed that most of the methane derived from H2/CO2 and formate as an energy source and less from acetate. Acetate is mainly used by sulfate-reducing bacteria in this river. By looking for interrelations between fermenting bacteria and methanogens, a new metabolic coupling between these bacteria was found: the interspecies formate transfer. In order to investigate the relationship between bacteria in the anoxic food chain, 10 bacteria fermenting cellobiose and 4 bacteria producing CH4 autotrophically (H2/CO2) were isolated from the anoxic sediment of the River Saar. At the sampling site, the river was so polluted that no invertebrates could be detected. In co-culture experiments, 18 combinations produced significant amounts of CH4. Six strains of cellobiose-fermenting and three strains of methanogenic bacteria were included in these positive combinations. Methanogenic and fermentative bacteria were isolated from anoxic river sediments. In co-culture experiments several homolactic streptococci produced formate instead of lactic acid. The formate was used as the sole energy source by the methanogens. By changing from lactate to formate metabolism, the streptococci gained 50% more energy, revealing the relation as a syntrophism called interspecies formate transfer. (Miller-PTT)
W89-11309

UPTAKE OF NUCLEIC ACID PRECURSORS BY AQUATIC MICROBIAL COMMUNITIES AND PURE CULTURES OF BACTERIA AND ALGAE.
Max-Planck-Inst. fuer Limnologie zu Ploen (Germany, F.R.). Abt. Mikrobenoekologie.
K. P. Wetzel.
Internationale Vereinigung fur Theoretische und Angewandte Limnologie, Verhandlungen IVTLAP, Vol. 23, No. 4, p 1865-1868, December 1988. 1 fig, 1 tab, 10 ref.

Descriptors: *Aquatic bacteria, *Algae, *Productivity, *Water sampling, *Culturing techniques, Incubation, Nucleic acids, Testing procedures.

A technique is described which should be useful in distinguishing between bacterial and algal activities, especially in those water samples with very small-sized algal species, where a separation by filtration fails. The measurement of the rates by which natural microbial communities in aquatic habitats synthesize their cellular nucleic acids (RNA and DNA) is frequently used to determine microbial production. These studies require the incubation of a water sample with (3H)-labelled precursors of the nucleic acids synthesis pathways. Several such precursors are possible, but methyl-3H thymidine and 2-3H adenine are the preferred ones. It has been suggested that thymidine is taken up only by bacteria. Algae and other higher organisms may not be able to incorporate extracellular thymidine into DNA. For adenine it has been shown that this purine nucleosid is used by many bacteria and most of the planktonic algae. Results of these experiments show that thymidine is not incorporated into DNA by any of the algae, whether green or blue-green. Of course, this may be true only for the particular strains tested. It cannot be ruled out that some species or strains which do use thymidine for DNA synthesis may be found. However, the algae tested here (particularly Oscillatoria, Chlorella, and Synechococcus spp.) at times dominate the phytoplankton of many lakes. In addition, microautoradiography with water from different lakes under conditions comparable to the uptake studies showed that none of the algal cells in the samples incorporated thymidine. Adenine was taken up by most of them. However, there were less than 20% of the total bacteria able to incorporate thymidine. (Miller-PTT)
W89-11310

MACRONUTRIENT INTERACTIONS INVOLVED IN CYANOBACTERIAL BLOOM FORMATION.
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A. R. Klemer, N. Detenback, J. Grover, and T. F. Brasino.
Internationale Vereinigung fur Theoretische und Angewandte Limnologie, Verhandlungen IVTLAP, Vol. 23, No. 4, p 1881-1885, December 1988. 3 fig, 19 ref.

Descriptors: *Lakes, *Aquatic bacteria, *Eutrophication, *Cyanophyta, *Nutrients, Buoyancy, Carbonates, Carbon.

Results are presented from a series of lake mesocosm experiments that indicate that neither the turgor-collapse hypothesis nor the polysaccharide-ballast scheme of buoyancy regulation accounts fully for the buoyancy increase involved in cyanobacterial bloom formation. Experiments were conducted with Oscillatoria agardhi var. isothrix in Deming Lake (Minnesota) and with Anabaena species in Lake Oscaleta (New York). In these low alkalinity lakes (0.4-0.6 meq/l in the photic zone), the effects of HCO3(-)-C enrichment on the vertical distribution of cyanobacteria at different levels of N and P availability were studied. The experimental apparatus was similar to that described by others; surface blooms of Oscillatoria were induced by enriching only the metalimnetic layers of isolated water columns. To test the hypothesis that our N and P additions had induced C limitation of photosynthesis, 2 mM NaHCO3 was added to one of two simultaneous blooms. The nutrient effects on the buoyancy of Oscillatoria have led to the conclusion that it is unlikely that cyanobacteria come to the surface for CO2 or inorganic N. A demand for C sub i or N sub i limitation is not essential to an increase in buoyancy and C sub i enrichment can promote bloom formation. The adaptive significance of bloom formation appears to have more to do with the competitive advantage gained by monopolizing incident radiation. With sufficient nutrients, cyanobacteria can balance photosynthesis and growth so as to maintain buoyancy as they migrate toward the surface, alter the light climate, and, in some cases, envelop the photic zone. (Miller-PTT)
W89-11312

EXTRACELLULAR PRODUCTS OF MICROCYSTIS SPECIES: FORMATION OF SLIME LAYER AND DOC POOL IN SURROUNDING WATERS.
Yamanashi Univ., Kofu (Japan). Faculty of Engineering.
Y. Ameniya, K. Kato, and O. Nakayama.
Internationale Vereinigung fur Theoretische und Angewandte Limnologie, Verhandlungen IVTLAP, Vol. 23, No. 4, p 1886-1892, December 1988. 9 fig, 1 tab, 14 ref. Grant-in-Aid for Special Project Research of the Ministry of Education, Science and Culture, Japan no. 60129034, 61134044 and 62124040.

Descriptors: *Cyanophyta, *Slime layer, *Carbon cycle, *Eutrophication, *Photosynthesis, Flux, Extraction, *Algae blooms, Lakes, Organic compounds.

It is essential to reveal the flux and chemical nature of extracellular release of photosynthesized organic compounds of Microcystis species in order to evaluate the function of Microcystis in the carbon cycle of eutrophic lake ecosystems. The function of the slime layer in the carbon flux is revealed while focusing on the behavior of its chemical constituents. An attempt was made to separate slime material of Microcystis species into two fractions as loosely and rather strongly bound to cell aggregates by physical treatment. The physical method used to extract slime fraction from cell aggregates cannot absolutely separate one slime from others. If a chemical procedure was applied using a 0.5 N-NaOH with 2% EDTA at 4 C to solubilize and extract the slime layer, about 20 or 30% of the total particulate organic materials (POM) was extracted. This concentration is sometimes significantly higher than that obtained by the physical treatment. When the amount of carbon

from the physically extracted slime fraction was compared to that obtained by chemical extraction, the extract effectivity of the former decreased clearly according to the change in the algal constituents. When M. viridis biomass increased, the contribution of the physically extracted fraction to the chemical extraction decreased. The role of the slime layer of M. viridis may differ from the other two species, M. auruginosa and M. wesenbergii. M. wesenbergii has a characteristic sheath material, which is at least resistant to physical shock. If the Microcystis species are dominant in a eutrophic lake, the constituents should be revealed. Otherwise, the function of the dominant species in a carbon flux of the ecosystem cannot be evaluated. (Miller-PTT)
W89-11313

STUDY OF THE FACTORS REGULATING SUCCESSION OF CYANOBACTERIA IN LAKE TJEUKEMEER, THE NETHERLANDS,

Limnologisch Inst., Oosterzee (Netherlands). Tjeukemeer Lab.
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Internationale Vereinigung fur Theoretische und Angewandte Limnologie, Verhandlungen IVTLAP, Vol. 23, No. 4, p 1894-1987, December 1988. 1 fig, 11 ref.

Descriptors: *Cyanophyta, *The Netherlands, *Algal growth, *Eutrophication, *Succession, Limiting nutrients, Diatoms, Polderwater.

Oscillatoria redekei, O. agardhii and Aphanizomenon flos-aquae are the abundant cyanobacteria in Lake Tjeukemeer. Multiple addition bioassays of water from Tjeukemeer suggested that algal growth was mainly N-limited. Field data and experimental results that will be used to identify in situ growth-limiting factors of the appropriate cyanobacteria are presented. Others have reported that, with the exception of 1974, between 1971 and 1983, maximum densities of Melosira spp. and of O. redekei were inversely related. This inverse relationship may be caused by factors affecting nutrient or trace metal availability. In 1974 and 1984, when there was no inverse relationship between maximum densities of Melosira spp. and O. redekei eutrophic and humic polderwater, as measured by increases in yellow water color in the lake, entered Tkeukemeer in spring at a time when numbers of O. redekei filaments increased rapidly. This drainage may have supplied a nutrient limiting the growth of O. redekei in the lake. This may explain the high numbers of this species occurring simultaneously with those of Melosira spp. Generally, O. agardhii is the only blue-green alga with high biovolume in Tjeukemeer throughout the summer. To identify its growth rate an attempt was made to find physiological characteristics suitable for simulation in culture studies. Some nutrient limitations (N, P) can cause yellowing of algal cultures due to increases in the ratio of carotenoids to chlorophyll-a. The carotenoids: chlorophyll-a ratio, the biovolume of O. agardhii and its proportion of the total algal volume were studied in 1983 and 1985. The high percentages for biovolume of O. agardhii show that the increases in the pigment ratio occur mainly in this organism. The pigment ratios were not only high in June and July 1983, but also thereafter. However, no increase in the ratio was noticed in the period after July 1985. This phenomenon may be related to the inlet of large volumes of polderwater during August, resulting in an almost doubling of the filtered lakewater. The supply and availability of some nutrient, trace metal, or both, may have increased because of the polderwater input, preventing an increase in the pigment ratio. (Miller-PTT)
W89-11314

COMPARISON OF ALGAL C14-UPTAKE AND GROWTH RATE IN SITU AND IN VITRO.

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Internationale Vereinigung fur Theoretische und Angewandte Limnologie, Verhandlungen IVTLAP, Vol. 23, No. 4, p 1898-1907, December 1988. 3 fig, 3 tab, 46 ref.

Descriptors: *Cyanophyta, *Diatoms, *Algal physiology, *Productivity, *Limnology, *Algal growth, *Eutrophication, Carbon radioisotopes, Inorganic carbon, Limiting nutrients, Growth rates, Lakes.

The C14-method was performed in two different lakes, chosen because of the dominance of algal species with known growth constants. The C14-method was compared with the decrease of total dissolved inorganic carbon, in order to consider the question 'under what condition does C14-uptake not measure the specific growth rate'. Emphasis is placed on comparison of estimated growth rates, which are not always equal to the net C14-uptake. However, as the change in the total dissolved inorganic carbon can be considered as the true net photosynthesis, it seems to be impossible to avoid the eternal question of 'gross and net'. The in situ measurements are complemented with comparisons in vitro, in incubators in the laboratory under different times of exposure (thereby estimating specific growth rate, and also from the change in particulate organic carbon). The growth constant, estimated earlier in the laboratory for the two blue-green algae Microcystis wesenbergii and Oscillatoria agardhi as well as for the diatom Stephanodiscus hantzchii v. pusillus, was valid for natural populations in the field of the same species. Measurements of C14-uptake should give estimates of growth during periods of balanced growth. Natural phytoplankton populations are considered often to be in a near steady state condition. That is probably why the short term C14-incubations in situ gave reasonable and accurate estimates of the growth rate of the three dominant algal species. However, it is not possible to make any further evaluations of the C14-method from these limited data. In order to interpret exactly what is being measured in general by the C14-method, it is necessary to get a deeper knowledge of the complex interactions between nutrient limitation, growth rates and C metabolism. (Miller-PTT)
W89-11315

PHOTOSYNTHETIC CHARACTERS OF A DEEPWATER BRYOPHYTE FROM A CLEAR, OLIGOTROPHIC LAKE IN WISCONSIN, U.S.A.

Wisconsin Univ., Madison. Inst. for Environmental Studies.
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Internationale Vereinigung fur Theoretische und Angewandte Limnologie, Verhandlungen IVTLAP, Vol. 23, No. 4, p 1912-1915, December 1988. 2 fig, 2 tab, 12 ref. NSF Grant no. BSR 85 06119.

Descriptors: *Light penetration, *Limnology, *Photosynthesis, *Lakes, *Oligotrophy, *Wisconsin, *Mosses, Liverworts, Soft water lakes, Shade tolerance, Chlorophyll, Carotenoids.

A preliminary study of the photosynthetic characters of the deepwater liverwort (Chiloscyphus rivularis), collected at 14 m depth in Crystal Lake (Wisconsin) are presented. Crystal Lake is a small, softwater oligotrophic seepage lake with sparse littoral vegetation extending to about 6 m depth. The photosynthesis/light curve indicated that these plants are shade adapted with a low light saturation level of about 50 micromols photons/sq m/s. The thalli had high concentrations of chlorophyll-a and chlorophyll-b and carotenoids which were found to consist mostly of lutein. Studies of the fluorescence spectrum of the whole thallus at 680 nm showed that light energy absorbed in a region characteristic of carotenoid absorption (470-500 nm) is transferred to chlorophyll-a. The light reaching the plants in the deepwater in Crystal Lake is largely of the wavelengths where carotenoid absorption is maximal. The light absorption characters and the substantial carotenoid content suggest that these pigments are important for photosynthesis in deepwater plants. (Miller-PTT)
W89-11317

SEASONAL STUDIES OF RESOURCE ALLOCATION IN A DEEPWATER BRYPOPHYTE FROM A CLEAR LAKE IN WISCONSIN, U.S.A.

Wisconsin Univ., Madison. Inst. for Environmental Studies.
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Internationale Vereinigung fur Theoretische und Angewandte Limnologie, Verhandlungen IVTLAP, Vol. 23, No. 4, p 1916-1919, December 1988. 2 fig, 10 ref. NSF Grant no. BSR 85 06119.

Descriptors: *Resource allocation, *Limnology, *Lakes, *Oligotrophy, *Wisconsin, *Mosses, *Limiting nutrients, Seasonal variation, Liverworts.

The seasonal patterns of resource allocation in the submersed liverwort Chiloscyphus rivularis is presented. The study population was grown in an oligotrophic lake poor in both inorganic and organic nutrients and dissolved inorganic carbon. The liverwort lives at such depths that it is subject to considerable light stress, exhibiting a number of responses to these conditions. Resource allocation in a plant limited by a series of environmental factors can be complex. However, this species may exhibit a more simplified pattern of allocation as the plant consists solely of a simple thallus. There are no specialized organs of storage or any roots. The submerged plants also do not undergo sexual reproduction. There is, therefore, unlikely to be a differentiation of resource allocation to different plant parts. The results of the nutrient analyses show that there is not generally a considerable change in the concentrations of the nutrients from April thru October. The most striking change occurs for nitrogen, which exhibits an increase at the end of the season. The initial potassium content is lower than for the rest of the season. However, other changes are quite small. Total nonstructural carbohydrates show a strong seasonal pattern. The initial level is low and there is a strong summer peak, which declines towards the end of the year. The results of the inorganic nutrient study show that there is no dilution, within the plant tissue, of the nutrients with the growth of the liverwort. Studies of the other aquatic macrophytes have shown two contrasting patterns. In plants such as the Myriophyllum spicatum, there is a strong seasonal pattern with major increases in tissue concentrations of inorganic nutrients whenever these constituents are abundant. However, in plants such as the isoetids, the tissue concentration remains constant over much of the year. The former pattern is typical of strong competitors and the latter of stress tolerators. The relatively constant pattern in most of the nutrients means that there is little evidence of luxury consumption. This would suggest that a number of the nutrients are limiting. (Miller-PTT)
W89-11318

SEASONAL AND SPATIAL BIOMASS VARIATION OF THE SUBMERGED MACROPHYTE, ISOETES OCCIDENTALIS, IN A SUBALPINE LAKE.

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Internationale Vereinigung fur Theoretische und Angewandte Limnologie, Verhandlungen IVTLAP, Vol. 23, No. 4, p 1920-1926, December 1988. 1 fig, 2 tab, 13 ref. NSF Grant BSR84-09448.

Descriptors: *Seasonal variation, *Spatial distribution, *Biomass, *Limnology, *Macrophytes, Organic matter, Nitrogen, Mountain lakes.

As part of a comprehensive study to investigate factors regulating the macrophyte distribution in Castle Lake (California), four patches of water were studied intensively to determine if they differed spatially or seasonally with respect to a number of biomass characteristics. A determination of macrophyte biomass was obtained to identify the major factors regulating plant colonization success and distribution. Biomass variation was less among seasons than among patches within a season for Isoetes occidentalis. This lack of seasonality is typical for isoetids. Tissue nitrogen concentrations increased from summer to mid-winter, when growth rates were low. This accumulation may provide a pool of nitrogen for periods of more rapid growth. Biomass characteristics of individual

Isoetes plants were well within ranges reported for other isoetids from a variety of sediment types. While low levels of organic matter in sediments have been shown to be beneficial to macrophyte growth, high levels can be detrimental. The extremely organic sediments of Castle Lake, however, support high Isoetes biomass levels within restricted patches. (Miller-PTT)
W89-11319

DISTRIBUTION OF SUBMERGED MACROPHYTES IN LAKE TAHOE, CALIFORNIA AND NEVADA, AND THE POSSIBLE INFLUENCE OF GROUNDWATER SEEPAGE,
Purdue Univ., Lafayette, IN. Dept. of Forestry and Natural Resources.
S. L. Loeb, and S. H. Hackley.
Internationale Vereinigung fur Theoretische und Angewandte Limnologie, Verhandlungen IVTLAP, Vol. 23, No. 4, p 1927-1933, December 1988. 4 fig, 2 tab, 23 ref.

Descriptors: *Limnology, *Seepage, *Sediment-water interfaces, *Macrophytes, *Lake Tahoe, Oligotrophic lakes, Groundwater, Sediments, Plant distributions.

The study of factors regulating the sparse occurrence of macrophytes in oligotrophic lakes affords researchers an opportunity to examine potential growth regulating factors among plant supporting and non-supporting areas. The objectives of this study were: (1) describe the distribution pattern of the submerged macrophytes in the shallow (0-10 m) littoral zone, (2) examine the seasonal growth pattern, and (3) determine whether differential groundwater seepage into the lake was associated with the growth distribution patterns of these plants. A survey of spatial distribution of submerged macrophytes revealed that these plants were very rare in the shallow (0-10 m) littoral zone of Lake Tahoe. Tracheophytes dominated the submerged aquatic plant beds. The two major macrophyte growth areas were adjacent to marshes along the shore. The importance of this relationship is not known although it may be related to chemical differences in seepage water, sediment type, or, historically, to periods when the lake level elevation was lower. The species composition within the plant beds was quite heterogeneous. A transect across the macrophyte bed illustrated how the species composition changes abruptly from myriophyllum spicatum and ceratophyllum demersum to potamogeton richardsonii. The sediment profile outside the plant bed showed it to be deep sands with low organic matter content while the sediment inside the bed was organic in composition until a coarse sand and pebble layer was reached approximately 20 cm below the sediment-lake interface. The chloride analyses on the lake and interstitial waters verified that interstitial water samplers were not drawing lake water back into the sediments. The increased amounts of chloride inside the plant beds compared to outside were believed to be the result of plant decomposition. For two nutrient species, ammonium and soluble iron, there were strong concentration gradients between the interstitial waters and the overlying lake waters. The movement of nutrients by diffusion across this gradient from sediment into lake would be relatively slow compared to movement into the lake due to groundwater seepage. (Miller-PTT)
W89-11320

LIGHT UTILIZATION EFFICIENCY AS A FUNCTION OF STORED CO2 IN LEAVES OF SOME ACIDTOLERANT AQUATIC MACROPHYTES.
Uppsala Univ. (Sweden). Limnologiska Institutionen.
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Internationale Vereinigung fur Theoretische und Angewandte Limnologie, Verhandlungen IVTLAP, Vol. 23, No. 4, p 1934-1939, December 1988. 5 fig, 30 ref.

Descriptors: *Limnology, *Acid rain effects, *Carbon, *Light penetration, *Carbon dioxide, *Macrophytes, *Primary productivity, *Photosynthesis, Leaves, Chlorophyll.

Carbon limitation is discussed as a possible controlling factor of primary productivity. Concomitantly with anthropogenically induced acidification of the natural environment and its aquatic habitats, the issue of inorganic carbon availability has become a truly modern undertaking. In contrast to alkaline waters, which reciprocally balance the three solute species H2CO3, HCO3(-) and CO3(--) against each other, the acidic aqueous medium with its simple domination of carbonic acid and free CO2 as a major source of inorganic carbon has offered a new avenue into the intricate relationships between net photosynthesis, respiratory CO2, light compensation and level of CO2 compensation. An attempt is made to illustrate some of these relationships by means of data obtained from experiments that rather precisely control photon flux density, as well as gas quantity within a closed chamber holding small pieces of juvenile leaf tissue of two well-known acidtolerant macrophytes of northern Europe. It is shown that, at least under non-alkaline conditions, the relationship between light utilization efficiency and available carbon dioxide is nearly linear. Therefore, it is feasible to trace, by extrapolation, the level of CO2 compensation as well as establish a relative measure of the photosynthetic potential of the selected organism and ambient medium in question. Likewise, if the photosynthetic organism assimilates exclusively free CO2 in the presence of bicarbonate, it should also be practicable to ascertain the difference in biologically obtainable CO2 between media (lake water) of various alkalinity. Linking assimilated inorganic carbon to converted light energy offers furthermore a simple means towards an assessment of the general physiological status of chlorophyll-bearing plant material. Therefore, the described plotting procedure could be used as a tool for assays of balanced nutrition. (Miller-PTT)
W89-11321

LEAF MATERIAL PRODUCTION IN NYMPHAEA LOTUS L.: IMPLICATIONS FOR SUSTAINED DETRITUS PRODUCTION.
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Internationale Vereinigung fur Theoretische und Angewandte Limnologie, Verhandlungen IVTLAP, Vol. 23, No. 4, p 1940-1944, December 1988. 1 fig, 22 ref.

Descriptors: *Flood plains, *Macrophytes, *Productivity, *Detritus, *Grasses, Leaves, Rivers, Seasonal variation, Decomposition.

Data are presented for three aquatic macrophytes Nymphaea lotus, Najas pectinatus and Potamogeton crispus and a terrestrial grass, Cynodon dactylon, which inhabits seasonally inundated areas on the Pongola river floodplain. Their cycles of production and decomposition are compared and discussed in the context of the floodplain functioning. Standing crop of the N. lotus leaf material showed distinct seasonal variation. The rate of production of leaf material was correlated with temperature between June 1985 and February 1986, but not thereafter because of a second peak in production which was caused by petiole extension as the plants responded to increased water depth following the flood in March. It is suggested that had the flood not occurred, production would have declined to reach low levels by mid-autumn. Leaf loss occurred throughout the year, but the rate was highest in summer. Since floating leaves of nymphaeids decompose rapidly, particularly when the water is warm, N. lotus is seen principally as a summer contributor to the secondary producers. In contrast, N. pectinatus is virtually absent from the lakes of the floodplain during summer and attained peak standing crop in late autumn and winter. Although loss rates were not measured, it is probable that N. pectinatus makes its greatest contribution to secondary producers during autumn and winter as standing crop declines. On the Pongolo river floodplain, the spatial and temporal separation of species, their periodicity, the nature of the material produced and the flooding regime appear to combine to reduce periodicity in supply of material to the detritivore populations. The importance of the alleged stability is not clear because insufficient information is known of the relative contribution of different species in one lake and how this changes in response to episodic events and gradual changes brought about by processes such as sedimentation. (Miller-PTT)
W89-11322

DECOMPOSITION OF PASPALUM DISTICHUM L.: METHODOLOGY IN SEASONALLY INUNDATED SYSTEMS.
University of the Witwatersrand, Johannesburg (South Africa). Dept. of Botany.
K. H. Rogers, and D. DeBruyn.
Internationale Vereinigung fur Theoretische und Angewandte Limnologie, Verhandlungen IVTLAP, Vol. 23, No. 4, p 1945-1948, December 1988. 3 fig, 8 ref.

Descriptors: *Flood plains, *Litter, *Decomposition, Lakes, Flooding, Leaves, Deterioration, Phosphorus, Nitrogen.

The rates of mass and nutrient loss from inundated Paspalum distichum plants rooted in plastic growth trays were compared with those from plants which were cut and placed in litter bags submerged in the field. The loss of mass from P. distichum leaves could be described by a simple exponential model in both treatments, but that for rooted plants in growth trays was more rapid than that for cut plants in litter bags. In contrast, mass loss from stems was linear and rooted stems lost mass much more slowly than those in litter bags. These differences are manifest in quite dissimilar patterns and rates of mass loss from the total above ground (leaf and stem) plant material in the two treatments. Changes in the nitrogen concentration of the detached plants in litter bags were quite different with no marked changes in the first 3 days followed by a decrease in concentration in the leaves and a steady increase in the stems to twice the original concentration. The most important difference in phosphorus concentration changes was that while rooted plants showed a gradual decrease in P concentration over a 50-day period, there was a rapid leaching loss from those in litter bags over the first three days of inundation. Phosphorus in plant tissue is labile and lost rapidly if membrane permeability is changed. The significance of decomposition studies in periodically inundated systems lies in the use of the data in predicting the amounts of energy (mass) and nutrients transferred from the terrestrial vegetation to the aquatic phase for particular periods of flooding. The calculation of nutrient transfers is made from estimates of the rate and pattern of overall loss of nutrient stocks from the plant material and these too differed markedly between growth tray and litter bag treatments. Thus, irrespective of the period of inundation for which predictions are made, estimates for nitrogen, phosphorus, and mass (energy) transfer to the aquatic phase would be affected by the enclosure of detached plants in litter bags. (Miller-PTT)
W89-11323

FLEXIBILITY OF LIFE CYCLE PATTERNS AS A MECHANISM FOR TOLERANCE OF FLUCTUATION OF ENVIRONMENTAL CONDITIONS BY AQUATIC PLANTS.
University of New England, Armidale (Australia). Dept. of Botany.
M. A. Brock.
Internationale Vereinigung fur Theoretische und Angewandte Limnologie, Verhandlungen IVTLAP, Vol. 23, No. 4, p 1949-1953, December 1988. 1 tab, 10 ref.

Descriptors: *Aquatic plants, *Life cycles, *Macrophytes, *Environmental effects, *Tolerance, Lakes, Wetlands, Substrates, Water depth, Grazing.

In fluctuating environments, the organisms best able to survive and reproduce are those which tolerate both maximum and minimum levels of environmental parameters. Studies in shallow Australian lakes are exploring the hypothesis that the submerged macrophytes may be adapted to wide fluctuations of environmental conditions rather than the extremes of each parameter. Evidence is presented on submerged macrophytes from saline

and freshwater ephemeral wetlands that suggests flexibility of life cycle pattern and morphological plasticity enhance survival in widely fluctuating environments. Preliminary data from transplant experiments in the freshwater species Myriophyllum variifolium were used to examine the variability and life cycle timing of this species. A factorial-design, transplant experiment was set up in October 1986 to test the effect of four habitat factors on the establishment and growth of this species. Depth of water, grazing, substrate type, and origin of the material were the primary variables. Different survival rates, shoot numbers, and shoot lengths are stimulated by depth. Overall, grazing does not have a marked effect on plant survival and establishment. However, results indicate a negative synergistic effect of the combination of grazing and 0.3 depth where only 2.5% survival occurred compared with 29% in the ungrazed site. The variability within a population of aquatic macrophytes may be maintained by wide fluctuations of environmental parameters. Researchers should not ignore the 'noise' within a species or population as it is upper and lower limits which provide the variation on which natural selection acts in extreme environmental conditions. The use of field transplant experiments to explore the reactions of individual plants to different environmental conditions is a technique with potential in bridging the gaps of extrapolation from laboratory physiological experimentation to field observations and vice versa. (Miller-PTT)
W89-11324

RADIUM ACCUMULATION FROM WATER BY FOILAGE OF THE WATER LILY, NYMPHAEA VIOLACEA.
Australian Nuclear Science and Technology Organisation, Sutherland. Environmental Science Div.
For primary bibliographic entry see Field 5B.
W89-11325

EFFECT OF INTERNAL SHOOT PHOSPHOROUS ON THE METABOLISM OF AN AQUATIC ANGIOSPERM, MYRIOPHYLLUM TRIPHYLLUM ORCHARD,
Auckland Univ. (New Zealand). Dept. of Botany.
M. R. Rattray, and J. M. A. Brown.
Internationale Vereinigung fur Theoretische und Angewandte Limnologie, Verhandlungen IVTLAP, Vol. 23, No. 4, p 1964-1968, December 1988. 5 fig, 10 ref.

Descriptors: *Phosphorus, *Nutrients, *Limiting nutrients, *Macrophytes, *Photosynthesis, Photorespiration, Angiosperms, Plantiology, Metabolism.

The effects of phosphorous on rates of photosynthesis, photorespiration and on the length of the induction phase in Myriophyllum triphyllum were studied. In M. triphyllum, the response to P at internal concentrations from 0.9 to 5.8 mg P/g dry wt. reveal no indications of the inhibitions which might well have been expected from the growth curve. Rather, the 1.9 fold increase in the rate of apparent CO2 fixation from 53 to 95 micromol CO2/g F.wt./h shows that net photosynthesis is stimulated by increasing P levels up to those found in the field. Inhibitions of apparent photosynthesis by P only occur at higher concentrations unlikely ever to be found in natural situations. The same range of P produced a greater relative stimulation in CO2 release from photorespiration (2.4 fold) but net photosynthesis was only slightly affected. This is because, in M. triphyllum, as in other aquatics, the rate of photorespiration is low relative to those of photosynthesis. As a percentage of apparent photosynthesis, photorespiration ranged from 15% at 8.8 mg P/g dry wt. to 37% at 1.8 mg P/g dry wt. The net effect of these responses of photosynthesis, in terms of rate, induction phase and changes in chlorophyll, and of photorespiration indicate that M. triphyllum is capable of maintaining a relatively high and even daily rate of carbon assimilation over a wide range of internal P concentrations. This contrasts markedly with the depressant effects of P on growth. The effects of phosphorous on growth of M. triphyllum cannot be explained by a simple parallel effect on carbon fixation as the resource for new plant structures. Phosphorous effects on growth results from other facets of metabolism which control plant development. (Miller-PTT)
W89-11326

INORGANIC SUSPENOIDS AND SUBMERGED MACROPHYTES IN LAKE WHANGAPE, NEW ZEALAND.
Ruakura Soil and Plant Research Station, Hamilton (New Zealand). Aquatic Plant Section.
R. D. S. Wells, W. N. Vant, and J. S. Clayton.
Internationale Vereinigung fur Theoretische und Angewandte Limnologie, Verhandlungen IVTLAP, Vol. 23, No. 4, p 1969-1972, December 1988. 3 fig, 6 ref.

Descriptors: *Lakes, *New Zealand, *Suspended sediments, *Macrophytes, Standing crops, Biomass, Growth rates, Suspensoids.

Suspended sediments and macrophytes in Lake Whangape (North Island, New Zealand) are assessed. Lake Whangape, the last of the larger lakes in Waikato lakes supporting dense macrophyte growths, aroused concern when it was observed that its Southern Arm had lost much of its dense macrophyte cover. Four sites were selected and botanical descriptions were made every 3 or 4 months from early 1985 to late 1986 using the qualitative SCUBA method. Three quadrants were harvested at each site and sorted into different species before drying to a constant weight at 80 C. Water samples were collected from throughout the lake and analyzed for inorganic suspensoids. Macrophyte biomass remained relatively constant over the 2 year study period indicating the tenfold difference in biomass between the Southern Arm and the rest of the lake was a relatively stable condition. However, for three years from 1977-79, the lake was sampled at 12 sites and the Southern Arm was at least as productive as the rest of the lake. Although the sampling techniques were not directly comparable with those used in this study, it is evidence that the Southern Arm has undergone a marked decline in macrophyte standing crop. The cause of macrophyte decline may have been due to any of one or a combination of factors such as phytoplankton blooms, epiphytes, swan browsing, grass carp (Ctenopharrygodon idella) or koi carp (Cyprinus carpio) activities, illegal herbicide use, changes in nutrient status of water and sediments, toxic outflows, plant senescence, or an increase in inorganic suspensoids. Preliminary results indicate that swan browsing and carp activities do not account for the present lack of macrophyte biomass in the Southern Arm as the exclusion cage in the Southern Arm showed no signs of increased production. (Miller-PTT)
W89-11327

EFFECTS OF NUTRIENTS ON AQUATIC PLANT DECOMPOSITION RATES,
Department of Scientific and Industrial Research, Taupo (New Zealand). Taupo Research Lab.
C. Howard-Williams, S. Pickmere, and J. Davies.
Internationale Vereinigung fur Theoretische und Angewandte Limnologie, Verhandlungen IVTLAP, Vol. 23, No. 4, p 1973-1978, December 1988. 2 fig, 18 ref.

Descriptors: *Lakes, *Eutrophication, *Nutrients, *Decomposition, *Limnology, *Macrophytes, *Aquatic plants, New Zealand, Nitrogen, Phosphorus, Plant tissue.

As part of a research program on the consequences of lake eutrophication in New Zealand, and partly as an effort to clarify the discrepancies in the literature, the influence of nutrient enrichment on rates of macrophyte decomposition were studied. Whether decomposition rates of a single test species were affected by nutrients at all is addressed as well as whether or not the supply in the surrounding water was more important than in the tissues. The decomposition rate of Lagarosiphon major was not affected by the concentrations of nutrients in the surrounding water in either field or laboratory studies. Tests spanned the concentration ranges (1-120 mg/cu m DRP and 5-1200 mg/cu m DIN) which are likely to occur in natural lake waters. The decomposition rate from day 2 to day 36 was not apparently affected by the nutrient quality of the tissue. These results are at variance with some of the data reported in other studies, so it is pertinent to examine more closely the existing data in the literature. The first point that emerges is that two distinct types of tissues have been studied: terrestrial leaf litter, usually in stream water, and aquatic macrophyte tissue. Secondly the decomposition responses to nutrients can be divided into two types: (1) responses to nutrients in the surrounding water, and (2) responses to nutrients in the tissues. In the literature examined, tissue nutrient levels had no effect on terrestrial litter decomposition. It is suggested that in the case of terrestrial litter in water, low tissue nutrients mean that bacterially mediated decomposition may be controlled by the rate of supply of aqueous N and P. The situation with decaying macrophytes, however, is quite different, as tissue nutrient levels are often much higher than in terrestrial litter. Examination of methods reported for several studies showed that while leaching was a recognized process in most, the authors had not separated leaching from microbially mediated decomposition in their calculations of decomposition rates or weight loss. (Miller-PTT)
W89-11328

LIGHT CLIMATE OF LAKE ELLESMERE AND ITS EFFECT ON THE GROWTH OF AQUATIC PLANTS,
Centre for Resource Management, Canterbury (New Zealand).
P. Gerbeaux, and J. C. Ward.
Internationale Vereinigung fur Theoretische und Angewandte Limnologie, Verhandlungen IVTLAP, Vol. 23, No. 4, p 1979-1984, December 1988. 3 fig, 2 tab, 13 ref.

Descriptors: *Lakes, *Light penetration, *Limnology, *Aquatic plants, *Suspended sediments, *New Zealand, Optical properties, Lake Ellesmere, Growth rates, Eutrophication, Wind, Water depth, Regression analysis.

Light parameters for use by water managers were assessed in order to get an accurate description of the light climate and its effects on plant growth in this particular shallow, eutrophic and brackish coastal lake. Water samples were taken fortnightly at two sites over the May-December 1986 period. The first site lies in a shallow sheltered bay and the other is located off the south western shore in a deeper zone where reflection from the lake bottom was accepted as being negligible regardless of the lake level. A wide range of optical measurements were obtained on several occasions. Shallow waters are likely to be affected by wind-induced resuspension of sediment. Therefore, their light climate will be typically controlled by the level of inorganic suspended solids in the water column. It is shown that this level can be accurately monitored by turbidity measurements once a relationship with absolute levels of suspended solids is established. When Lake Ellesmere and other New Zealand lakes studied are compared, it is very clear that the contribution of the total suspended solids has somewhat less effect on the attenuation coefficient than expected. This could be due to the brackishness of the water and its effect on electrostatic repulsion between particles which decreases as salinity increases, promoting the aggregation and precipitation of colloidal clay minerals and reducing scattering coefficient values. It is believed that the wind is a major factor controlling the level of suspended solids in this shallow lake. This has been demonstrated for other shallow lakes in New Zealand. It appears that daily average wind speeds, equal or greater than 3 m/s, significantly increase the level of inorganic suspensoids. By using the regression, an increase from 110 g/cu m to 180 g/cu m in the level of inorganic suspensoids will increase the attenuation coefficient, Kd, from approximately 8 to 11. The reduction of light penetration which reduces macrophyte growth in Lake Ellesmere appears to be more dependent on climatic conditions rather than on shading by algae as might be suggested by its continuously highly eutrophic status. (Miller-PTT)
W89-11329

LIMITS TO THE SPREAD OF ELODEA CANADENSIS IN LAKE ALEXANDRINA, NEW ZEALAND.
Centre for Resource Management, Canterbury (New Zealand).
J. C. Ward, J. M. Talbot, and I. D. Stewart.
Internationale Vereinigung fur Theoretische und Angewandte Limnologie, Verhandlungen IVTLAP, Vol. 23, No. 4, p 1985-1990, December 1988. 1 fig, 4 tab, 14 ref.

Descriptors: *Lakes, *New Zealand, *Environmental effects, *Aquatic plants, *Weeds, *Elodea, Growth rates, Iron, Lake Alexandrina.

The distribution of Elodea canadensis in Lake Alexandrina (South Island) was examined and environmental factors which might have limited the spread of dense stands in the lake were assessed. The invasion of E. canadensis in Lake Alexandrina has not caused the disappearance of native species at the rate previously envisaged and the distribution pattern of this species has been maintained over the past four years. The spread of stands of E. canadensis in the Chara globularis beds may be limited by the tendency of the latter species to collapse upon itself after reaching a height of 1 m in spring. However, this mechanism alone is unlikely to play a major role in limiting the spread of E. canadensis since very dense stands have become established in more sheltered parts of the lake in the C. globularis zone to a depth of 6-7 m. A critical iron requirement is reported for E. canadensis although others have found that growth of this species was unrelated to the concentration of iron in the interstitial water. In lake Alexandrina, a ferrous iron level of 1 mg/l was sufficient to support at least temporary growth of this species. It is believed that E. canadensis has not become a nuisance because the steep slopes and turbulence characteristic of the lake have not allowed it to establish permanent dense stands in many areas. (Miller-PTT)
W89-11330

EPISCHURA DENSITY AS A FACTOR CONTROLLING THE ESTABLISHMENT OF BOSMINA POPULATIONS IN LAKE TAHOE.
California Univ., Davis. Div. of Environmental Studies.
E. Narnhagen, E. R. Byron, and C. R. Goldman.
Internationale Vereinigung fur Theoretische und Angewandte Limnologie, Verhandlungen IVTLAP, Vol. 23, No. 4, p 2082-2086, December 1988. 4 fig, 11 ref. NSF Grant BSR 83-04916.

Descriptors: *Zooplankton, *Limnology, *Lake Tahoe, *Vertical distribution, *Predation, Lakes, Seasonal variation, Colonization, Competition.

Conditions are explored under which Bosmina longirostris populations can successfully colonize Lake Tahoe and coexist with Mysis relicta. The timing of the decline of Epischura in the late summer and autumn months is probably the most important factor determining whether Bosmina will occur in any given year. If Epischura populations decline in August or September, Bosmina is free to grow throughout September and October and can achieve high densities depending on food availability. If Epischura populations persist into October or November before declining in abundance, Bosmina will not be able to colonize the lake because of inherent resting egg production and declining ambient temperatures. The impact of Mysis predation on Bosmina populations has apparently been to shift Bosmina vertical distribution higher in the water column. Bosmina population abundance is now controlled by Epischura abundance to a large extent. In short, Bosmina populations in Lake Tahoe do not exhibit high enough birth rates to overcome the impact of invertebrate predation and their ability to colonize the lake is essentially controlled by the population behavior of their predators. (Miller-PTT)
W89-11331

LONG TERM STUDIES ON SIMULIUM VITTATUM ZETT. (DIPTERA: SIMULIIDAE) IN THE RIVER LAXA, NORTH ICELAND, WITH PARTICULAR REFERENCE TO DIFFERENT METHODS USED IN ASSESSING POPULATION CHANGES.
Iceland Univ., Reykjavik. Biological Inst.
G. M. Gislason, and A. Gardarsson.
Internationale Vereinigung fur Theoretische und Angewandte Limnologie, Verhandlungen IVTLAP, Vol. 23, No. 4, p 2179-2188, December 1988. 9 fig, 21 ref.

Descriptors: *Aquatic insects, *Benthic fauna, *Iceland, *Population dynamics, River Laxa, Bottom sampling, Window traps.

Two different sampling methods, benthic samples and window traps, were simultaneously employed in a study of population changes of Simulium vittatum in the River Laxa (North Iceland). The results of benthic samples were analyzed by two methods, one based on the Allens curve and the other based on the average cohort method, to estimate biomass and production. The two methods yielded closely similar results regarding both biomass and production. Of the two methods, the average cohort method is less laborious. Although they cannot be used as an absolute measure of abundance, window traps provide a simple and fast means of estimating blackfly population levels. Traps are affected by weather, especially wind velocity and temperature which influences flight activity of the insects. Also, window traps catch insects that originate from an undefined area. The catch of adult S. vittatum in window traps was closely related to the production of S. vittatum larvae and pupae. In view of this, population changes of S. vittatum can be monitored by using only window traps, a much less time consuming method than any other. (Miller-PTT)
W89-11332

IMPORTANCE OF LOW FLOW RATES TO THE PHOSPHOROUS FLUX BETWEEN LITTORAL AND PELAGIAL ZONES,
Helsinki Univ., Lammi (Finland). Lammi Biological Station.
T. Kairesalo, and T. Matilainen.
Internationale Vereinigung fur Theoretische und Angewandte Limnologie, Verhandlungen IVTLAP, Vol. 23, No. 4, p 2210-2215, December 1988. 4 fig, 2 tab, 11 ref.

Descriptors: *Lakes, *Limnology, *Phosphorus, *Littoral zone, *Pelagic zone, Lake breezes, Water circulation, Lake sediments.

The flow environment within an emergent macrophyte stand was investigated, paying special attention to the exchange of water between the littoral and pelagic areas. Although seasonal fluctuations of both total phosphorus and PO4-phosphorus was most striking in the innermost littoral zone, the peaks in the different zones were measured on the same dates and suggested an interchange between the littoral and pelagial areas. Laboratory experiments showed that even relatively slow flow of pelagial water, containing at most 5 microg PO4-P/L could effectively flush available phosphorus from the littoral sediment. A faster flow flushed the surface of sediment in 25 minutes, but also caused fluctuation in the PO4-P outflow most likely due to pertubation of the sediment and resuspension of benthic surface material. A similar flow rate was observed to produce turbidity in the field. Knowing the inflow and outflow velocities and the corresponding phosphorous concentration, transport of phosphorous by water flow from littoral to pelagial areas could be estimated by a mass balance calculation. Although ignoring turbulence, the results indicate the magnitude of transport by outflow and emphasize the importance of ambient flows in the littoral dynamics. Phosphorus release from the sediment could supply only a small fraction of the total outflow. In the innermost littoral, where anoxic periods in the overlying water are usual, the release rate might have been higher than measured under laboratory conditions. On the other hand, the throughflow system gave a release rate twice that of the batch system and almost thrice that measured by others for the littoral sediment of an oligotrophic lake. Relatively slow flow induced by winds towards the littoral, may flush the whole vegetation zone with pelagial water in a few hours. This process can cause a sudden nutrient peak in the inshore pelagial water. (Miller-PTT)
W89-11334

ECOLOGY OF INDIAN INLAND SALINE LAKES: II. PRIMARY PRODUCTION IN DIDWANA LAKE.
Jodhpur Univ. (India). Dept. of Zoology.
S. C. Bhargava.
Internationale Vereinigung fur Theoretische und Angewandte Limnologie, Verhandlungen IVTLAP, Vol. 23, No. 4, p 2217-2220, December 1988. 2 fig, 1 tab, 19 ref.

Descriptors: *India, *Limnology, *Saline lakes, *Primary productivity, *Phytoplankton, Alkalinity, Didwana Lake, Seasonal variation, Cyanophyta, Chlorophyll, Algae.

Investigations were carried out for a period of one annual cycle, October 1984 to September 1985, covering three seasons: winter, summer and monsoon. Lake salinity showed a wide variation ranging between 18.96 ppt to 336 ppt. Total alkalinity also increased considerably during the observation period, from a minimum of 148.0 ppm to a maximum of 1208. ppm. Such high alkalinity and salinity classify the lake as a 'highly alkaline saline' one. The total phytoplankton population varied from nil to 3,991,600 cells/L. The maximum density was observed at salinity 34.7% to which blue-green algae contributed the most both in number and genera. Total chlorophyll content showed concomitance with the total phytoplankton population and ranged from nil to 29.33 mg/cu m. Chlorophyll-a was found to be the dominant phytopigment. The maxima of both gross and net primary production were during the monsoon period (August 1985), synchronous with the monsoon peak of the phytoplankton. The production, on the whole, was low during the winter, which coincided with low phytoplankton density and in turn with low concentration of total chlorophyll, thereby establishing a positive relationship of primary productivity with phytoplankton population and chlorophyll concentration. As is true for most saline lakes, high salinities, followed by a depletion in phytoplankton population, acted as a limiting factor for phytoplankton primary production in Didwana Lake. (Miller-PTT)
W89-11335

TWO DIMENSIONAL MODELLING OF RESERVOIR OUTFLOWS.
Western Australia Univ., Nedlands. Centre for Water Research.
G. C. Hocking, and J. C. Patterson.
Internationale Vereinigung fur Theoretische und Angewandte Limnologie, Verhandlungen IVTLAP, Vol. 23, No. 4, p 2226-2231, December 1988. 2 fig, 10 ref.

Descriptors: *Reservoirs, *Reservoir releases, *Reservoir operation, *Model studies, Two-dimensional models, Algorithms, Outflow, Simulation.

New algorithms for inflow and withdrawal are discussed that can provide long term estimates of density structure, yet allow the basic model structure to remain one dimensional and retain the computational efficiency. An example showing some simple tracking of particles demonstrates the differences between several withdrawal algorithms used in these models. A single day's inflow is tracked as it travels into the main basin of the reservoir over a seventeen-day period. The inflow is assumed to be some form of effluent, and the water quality implications can be seen using three different algorithms: Method 1, which assumes variations in horizontal velocity only in the vertical; Method 2, which assumes variations in horizontal velocity only in the horizontal; and method 3, a new algorithm using two-dimensional motions. Withdrawal envelopes were calculated using the three withdrawal algorithms. The new algorithm will withdraw the most of the three. The first method withdraws the second largest amount, being not too different from the new method because the withdrawal is quite small. The second method misses the intrusion completely, and hence

withdraws none of the pollutant. The subsequent plunging of the following inflows to beneath this level may then force this water up and away from the region of the offtake. Thus the three methods result in completely different amounts of pollutant being withdrawn from the reservoir. This improved capability in following two dimensional motions is in no way intended to replace a more sophisticated pseudo-two-dimensional model, but it can be used to obtain some estimate of horizontal structure. The algorithms have been constructed for use in the dynamic reservoir simulation model DYRESM although the concept is generally applicable to Lagrangian layer models. Some quite simple alterations to the algorithms which model withdrawal and inflow in the reservoir simulation model DYSREM introduce a basic two-dimensionality to the model. This added capability is used to show the importance of choosing the correct region of withdrawal when horizontal transport is of interest, even for quite small withdrawals that have little effect on the vertical one-dimensional structure. (Miller-PTT)
W89-11336

DENITRIFICATION AND NITROGEN FIXATION IN AN AMAZON FLOODPLAIN LAKE.
California Univ., Santa Barbara. Dept. of Biological Sciences.
J. M. Melack, and T. R. Fisher.
Internationale Vereinigung fur Theoretische und Angewandte Limnologie, Verhandlungen IVTLAP, Vol. 23, No. 4, p 2232-2236, December 1988. 2 tab, 6 ref. NSF Grants DEB 78-23642, DEB 81-11398 and BJR-0794.

Descriptors: *Limnology, *Nutrients, *Lakes, *Flood plains, *Nitrogen fixation, *Denitrification, *Amazon River, Nitrogen, Phosphorus.

As part of a comprehensive study of the input, recycling and loss of nitrogen and phosphorus in an Amazon floodplain lake, measurements were made of the rates of nitrogen fixation and denitrification. These are the first such data reported for the Amazon and among the few available for tropical lakes in general. Measurements of nitrogen fixation were made using the acetylene reduction and 15N-N2 methods during periods of rising, high, and falling water in 1980 and 1981. No reduction of acetylene was detectable during incubations of any plankton samples from the open water of L. Caalado. Significant acetylene reduction was detected in samples of periphyton growing on aquatic macrophytes. Rates were highest during the day and lower at night. Nitrous oxide accumulation as evidence for denitrification was not detectable in any of the samples from L. Calado. Optimization of the assay to reduce the detection limit is required to establish if low rates of denitrification occur. The low concentration of nitrate in most of the samples indicates that a low supply of substrate may be one reason for these results. However, evidence suggests that denitrification remains probable or possible under some circumstances or at other times on Amazon floodplains. Nitrous oxide concentrations were below saturation in samples obtained from a variety of floodplain lakes scattered throughout the central basin and were near zero in anoxic waters of these lakes. Samples from 0.5 and 5 m in L. Calado were also unsaturated. These results imply a process such as denitrification that consumes nitrous oxide. Furthermore, nitrate added to bottom chambers installed in anoxic sediments in L. Calado was lost from the overlying water; denitrification is one possible route of the loss. Estimates derived from very limited data suggest an important role for nitrogen fixation and denitrification in the nitrogen balance for the overall Amazon basin. Data suggest that significant rates of N2 fixation are associated with the periphyton of floating macrophyte beds, but further direct measurements of nitrogen transformations in the full range of aquatic and terrestrial habitats are needed to improve basin-wide estimates for the Amazon. (Miller-PTT)
W89-11337

EXTREME PERTURBATION OF THE ZOOPLANKTON COMMUNITY OF A SMALL PRECAMBRIAN SHIELD LAKE BY THE ADDITION OF NUTRIENTS.
Department of Fisheries and Oceans, Winnipeg (Manitoba). Freshwater Inst.
D. F. Malley, P. S. S. Chang, D. L. Findlay, and G. A. Linsey.
Internationale Vereinigung fur Theoretische und Angewandte Limnologie, Verhandlungen IVTLAP, Vol. 23, No. 4, p 2237-2247, December 1988. 6 fig, 1 tab, 31 ref.

Descriptors: *Eutrophication, *Limnology, *Lakes, *Zooplankton, *Nutrients, *Experimental basins, Perturbation, Productivity, Rotifers, Crustaceans, Nitrogen, Phosphorus.

From 1975, Lake 227 in the Experimental Lakes Area (northwestern Ontario) has recieved experimental addition of N and P in a ratio of 5:1 and the response of the zooplankton population to this fertilization regime for the years 1977 to 1982 is examined. The hypothesis that chemical conditions are toxic to crustacean zooplankton and that Chaoborus controls rotifer abundance is further tested. The addition of N and P to Lake 227 in a 5:1 ratio stimulated primary productivity as effectively as did the same amount of P in a N:P ratio of 15:1. Phytoplankton production produced high pH and anoxic conditions in the water column. Populations of cladocerans and calanoids were reduced to very low numbers, during most of the years of fertilization. Cyclopoids were slightly less affected. The toxic chemical conditions are considered the most unlikely cause of the loss of crustaceans. Total rotifer abundance was variable from year to year and was not correlated with inferred abundance of Chaoborus, and two species of rotifers, Anuraeopsis fissa and Polyarthra remata increased in abundance in the alkaline conditions. Lake 227 is a lake almost devoid of crustacean herbivores. Herbivory on edible phytoplankton has, therefore, been reduced by the apparently toxic chemical conditions produced by the high primary production. As a result, rotifers have increased in abundance to fill the niche left by crustaceans. (Miller-PTT)
W89-11338

RECYCLING OF MARINE ELEMENTS TRANSPORTED INTO FRESHWATER SYSTEMS BY ANADROMOUS SALMON.
Juneau Center for Fisheries and Ocean Sciences, AK.
O. A. Mathisen, P. L. Parker, J. J. Goering, P. H. Poe, and R. S. Scalan.
Internationale Vereinigung fur Theoretische und Angewandte Limnologie, Verhandlungen IVTLAP, Vol. 23, No. 4, p 2249-2258, December 1988. 4 fig, 3 tab, 21 ref.

Descriptors: *Limnology, *Radioisotopes, *Cycling nutrients, *Anadromous fish, *Salmon, *Trophic level, Food chains.

Stable isotope ratios were used to verify the hypothesis that marine nutrients, principally nitrogen, transported from the sea to freshwater by salmon escapement, are traceable to different trophic levels and enhance system fertility. The sockeye salmon runs to the Kvichak River have a pronounced cyclic nature with a period of 4-5 years, depending upon the average length of freshwater residence of the juveniles. Escapements have ranged from 225,000 to 24 million, and the numbers of juveniles reflect the same variations. Whereas the biogenic enrichment through the salmon carcasses cannot explain the establishment of cyclic salmon runs, they do provide a feedback loop which sustains the variable amount of juvenile biomass. The preliminary results indicate that a strong isotopic signature can be detected from nutrients released by returning anadromous salmon and that it can be traced as it makes its way up the food chain to juvenile salmon and other resident fish species. In Iliamna Lake, results suggest that periphyton utilizes the marine nutrients brought in by returning adult salmon first. The probable sequence is from carcass to periphyton, especially in the littoral zone, and then to feeding salmon fry the following spring. By late July, the salmon fry enter the limnetic zone of Iliamna Lake. Whereas the food requirements of the juvenile salmon are less during the first year of lake residence, it increases drastically during the second year. The principal limnetic food item, Cyclops scutifer, has a 2-year lifespan which is largely synchronized with the freshwater residence of the juvenile sockeye salmon. Eventually, the biogenic nutrients contributed by the returning anadromous salmon are lost through discharge from the system or deposited as sediments at the deeper parts of Iliamna Lake. (Miller-PTT)
W89-11339

RELATIONSHIPS BETWEEN SEEPAGE CHEMISTRY AND FLOW PATH THROUGH THE NEAR-SHORE SEDIMENTS OF AN ACIDIC LAKE.
Old Dominion Univ., Norfolk, VA. Dept. of Civil Engineering.
For primary bibliographic entry see Field 5C.
W89-11341

EFFECTS OF SUBMERGENT MOSS ON SEDIMENT SULFATE REDUCTION RATES.
Wisconsin Dept. of Natural Resources, Madison.
S. R. Greb, and P. J. Garrison.
Internationale Vereinigung fur Theoretische und Angewandte Limnologie, Verhandlungen IVTLAP, Vol. 23, No. 4, p 2267-2272, December 1988. 3 fig, 1 tab, 15 ref.

Descriptors: *Limnology, *Water chemistry, *Lakes, *Mosses, *Sulfates, *Sediments, Reduction, Vegetation, Anaerobic conditions.

Using the hypothesis that vegetative cover may be one of the factors accounting for the descrepancies seen in sulfate reduction rates, the effect a submergent moss layer has on the rate of sulfate reduction was quantified. Crystal Lake in northcentral Wisconsin was chosen as the study site. In situ sampling of sediment interstitial waters was performed in order to determine net sulfate fluxes into or out of the lake's sediment. Sulfate reduction occurred at all sites in Crystal Lake. The mean sulfate reduction rates at the S (shallow water with sandy bottom), B (soft, highly organic gyttja), and M (thick moss layer) sites were 66.5, 135 and 93 microeq/sq m/day, respectively. All 15 m hypolimnetic sites of Crystal Lake exhibited comparable sulfate reduction rates but an interesting phenomenon was seen at the M sites. When sulfate concentration profiles in moss covered areas are compared to adjacent exposed areas, one can clearly see that the sulfate reduction is taking place above the sediment-water interface in the moss covered areas. Though one might suspect that photosynthetic oxygen production in this 10-25 cm thick moss layer might suppress this anaerobic process, the opposite was seen. It appears that the summer rate of sulfate reduction in moss covered areas does not differ from other areas in the lake but the zone of reduction in relation to the sediment-water interface is markedly different. This fact appears to influence the net annual retention of sulfur in the lakes system. (Miller-PTT)
W89-11342

EFFECTS OF ACIDIFICATION ON THE INVERTEBRATE PORTION OF THE AUFWUCHS IN A MESOCOSM EXPERIMENT,
Wisconsin Dept. of Natural Resources, Madison.
For primary bibliographic entry see Field 5C.
W89-11343

EARLY ZOOPLANKTON RESPONSE TO EXPERIMENTAL ACIDIFICATION IN LITTLE ROCK LAKE, WISCONSIN, USA.
Wisconsin Univ.-Madison. Center for Limnology.
For primary bibliographic entry see Field 5C.
W89-11344

PATHOGENICITY OF THE FUNGUS, COLLETOTRICHUM GLOEOSPORIOIDES (PENZ.) SACC., TO EURASIAN WATERMILFOIL (MYRIOPHYLLUM SPICATUM L).
Wisconsin Univ.-Madison. Dept. of Plant Pathology.
For primary bibliographic entry see Field 4A.
W89-11363

CONTINUOUS GROWTH AND CLUMP MAINTENANCE OF POTAMOGETON CRISPUS L. IN NARUTOH RIVER, JAPAN.
Shimane Univ., Matsue (Japan). Faculty of Science.
H. Kunii.
Aquatic Botany AQBODS, Vol. 33, No. 1/2, p 13-26, March 1989. 6 fig, 2 tab, 34 ref.

Descriptors: *Japan, *Stream biota, *Aquatic plants, *Plant growth, Rivers, Lotic environment, Plant stems.

To account for the continuous growth and clump maintenance of Potamogeton crispus L. in a lotic habitat, phenological and quantitative observations were made in a small river in Japan from April 1981 to August 1982. Favorable water temperatures (8.7-24.7 C) for shoot growth prevailed throughout the study period and the adventitiously rooting shoots grew successively from buried stems and rhizomes all the year round. Total stem length (including above--and underground stems) reached a maximum of 4690 m/sq m in April 1982. Flowering and turion formation occurred almost simultaneously from late May until late October when water temperatures were higher than 20 C and the photoperiod was longer than 12 h. Though the plant produced numerous turions (>9600 turions/sq m/year), they were small (5-15 mg dry wt/turion) and assumed to be less important than underground stems for clump maintenance; while the stems were firmly rooted in bottom sand and protected by sediment from being swept away, most of turions were washed downstream immediately after they detached from the parent shoots. Among the total number of turions collected, only 2.7% were those which remained and germinated in the clump. (Author's abstract)
W89-11364

PRIMARY PRODUCTION IN A SHALLOW EUTROPHIC LAKE DOMINATED ALTERNATIVELY BY PHYTOPLANKTON AND BY SUBMERGED MACROPHYTES.
Otago Univ., Dunedin (New Zealand). Dept. of Zoology.
S. F. Mitchell.
Aquatic Botany AQBODS, Vol. 33, No. 1/2, p 101-110, March 1989. 2 fig, 1 tab, 36 ref.

Descriptors: *Eutrophic lakes, *Aquatic plants, *Submerged plants, *Limnology, *Primary productivity, *Phytoplankton, Macrophytes, Biomass, Seasonal variation, New Zealand, Succession.

Tomahawk Lagoon No. 2, a shallow eutrophic New Zealand lake, has shown irregular cyclic variations between phytoplankton and macrophyte dominance since 1963. During a 4-year study, which encompassed a change from phytoplankton to macrophyte biomass, there was a large decline in phytoplankton biomass and production, and an increase in macrophyte biomass. However, there was little increase in the macrophyte production, and the total primary production of the lake declined sharply, by a factor of 4. The effects of phytoplankton having better access to the available light and a longer growing season, and the more rapid nutrient cycling expected among planktonic communities, clearly outweighed those of macrophytes having access to sediment nutrients in this lake. Grazing by black swans was calculated to have removed about 15-25% of the production of macrophytes during their growing season, or 20-50% per annum. (Author's abstract)
W89-11367

LEAD ACCUMULATION AND LOCATION IN THE SHOOTS OF THE AQUATIC LIVERWORT SCAPANIA UNDULATA (L.) DUM. IN STREAM WATER AT GREENSIDE MINE, ENGLAND.
National Inst. for Environmental Studies, Ibaraki (Japan).
For primary bibliographic entry see Field 5B.
W89-11368

STRONG EFFECTS OF FORAGING MINNOWS ON A STREAM BENTHIC INVERTEBRATE COMMUNITY.
State Univ. of New York at Albany. Dept. of Biological Sciences.
J. F. Gilliam, D. F. Fraser, and A. M. Sabat.
Ecology ECPLAR, Vol. 70, No. 12, p 445-452, April 1989. 8 fig, 1 tab, 45 ref.

Descriptors: *Fish behavior, *Predation, *Stream biota, *Population density, *Benthic fauna, *Chubs, Fish, Invertebrates, Spatial distribution, Oligochaetes, Isopods, Growth.

Behavioral responses to piscivorous fish are known to alter the spatial distribution of small invertebrate-feeding fish in streams, producing concentrations of small fish in safer areas. Whether such a variation in the local density of small juvenile creek chubs (Semotilus atromaculatus) would, in turn, produce local alterations in the stream benthic invertebrate community was investigated. Replicated treatments of 0, 2 and 6 juvenile chubs per 0.5 sq m enclosure were established in a warm-water, soft sediment stream. Over a 3-month period, the presence of fish resulted in reductions of 79-90% in total invertebrate volume relative to the zero-fish treatments. Numbers were reduced 55-61%. The two major taxa, Oligichaeta and Isopoda, showed strong fish effects, and the size distributions of these two taxa showed shifts to smaller sizes. Densities of less abundant taxa showed no statistically significant fish effects. Evenness of the invertebrate community increased in the presence of fish. No differences in invertebrate densities were detected between the two-fish and six-fish treatments; however, the above-sediment activity of Oligochaeta was reduced more in the six-fish treatment than in the two-fish treatment, and growth of the fish was slower in the six-fish treatment. Unlike previous experimental studies in stony streams, this experiment shows that foraging fish can significantly alter the behavior, population structure and community structure of stream benthic invertebrates. (Author's abstract)
W89-11370

REPLICATION AND TREATMENT STRENGTH IN WHOLE-LAKE EXPERIMENTS.
Wisconsin Univ.-Madison. Center for Limnology.
S. R. Carpenter.
Ecology ECPLAR, Vol. 70, No. 12, p 453-463, April 1989. 8 fig, 1 tab, 45 ref. NSF grant BSR-86-06271.

Descriptors: *Experimental design, *Limnology, *Fish management, *Lakes, *Primary productivity, Experimental data, Replicates, Manipulations.

The numbers of replicates and magnitudes of manipulation needed to detect changes in lake primary productivity resulting from piscivore manipulations was examined. Substantial (about 10 times changes in the independent variable, piscivore biomass) and sustained (at least 3-5 year) manipulations using five reference and five experimental ecosystems produced significant t-test results in >80% of simulated experiments. The need for substantial and sustained manipulations is consistent with published results of whole-lake experiments on nutrient inputs, chemical contaminants, and the biota. In many cases, limited numbers of experimental systems or high costs will prevent adequate replication of ecosystem experiments. When large-scale experiments employ insufficient replicates and/or modest pertubations of the independent variate, there is great risk of erroneously accepting the hypothesis of no treatment effect. Therefore, unreplicated paired-system experiments (one reference and one experimental system) are often preferable even though classical statistics cannot be used to determine whether manipulation caused a change in the experimental system. A series of unreplicated paired-system experiments, staggered in time and performed in many locations, will provide more ecological insight than a replicated experiment in a single region. Few statistical methods pertain to large-scale ecological experiments; innovations could be very beneficial. (Author's abstract)
W89-11371

BIOLOGICAL ASSESSMENT OF THE WATER QUALITY IN SOUTH-HOLLAND (THE NETHERLANDS).
Hoogheemraadschap van Rijnland, Leiden (Netherlands).
For primary bibliographic entry see Field 7B.
W89-11390

ENERGY TRANSFER IN A KASHMIR HIMALAYAN SAR (LAKE).
Central Inland Capture Fisheries Research Inst., Barrackpore (India).
K. K. Vass, H. S. Raina, R. K. Langer, and S. Sunder.
Internationale Revue der Gesamten Hydrobiologie IGHYAZ, Vol. 73, No. 4, p 547-558, 1988. 32 ref.

Descriptors: *Mountain lakes, *Himalayan Mountains, *Primary productivity, *Limnology, *Energy transfer, Ecosystems, Phytoplankton, Lake ecosystems, Trophic level, Calcium, Bicarbonates, Oxygen depletion, Lake fisheries, Alkaline water, Zooplankton, Biomass.

The energy transfer at different trophic levels in a temperate lake, locally called Sar, ecosystem has been investigated. The lake investigated is situated in the Kashmir Himalayan region North of Srinagar. No stable thermal stratification was observed. The lake water is alkaline and well-buffered. Calcium is the dominant cation and bicarbonate the dominant anion. Oxygen depletion occurs at the bottom during summer. Primary production per day fluctuated from 93 to 2844 mg C/sq m and mean annual production was estimated at 327 g C/sq m. The phytoplankton biomass ranged from 0.9 to 27.6 g/ sq m and that of zooplankton between 1.44 and 16.06 g/sq m. Total phytoplankton production, in terms of energy fixation, has been estimated at 3200000 cal/sq m/y, out of which the fish harvest amounts to 2460 cal/sq m/y.The energy transfer at different trophic levels indicated that the system is inefficient. The conversion efficiency between primary production and fish production was estimated at 0.082. Besides other ecological parameters studied here, suggestions for the efficient use of other available energy from the system has been highlighted. (Miller-PTT)
W89-11392

HISTORIC TRENDS IN LAKE MICHIGAN SILICA CONCENTRATIONS.
Michigan Univ., Ann Arbor. Great Lakes Research Div.
For primary bibliographic entry see Field 5C.
W89-11393

CONTRIBUTION OF SEASONALLY FLOODED LANDS AND MINOR TRIBUTARIES TO THE PRODUCTION OF COHO SALMON IN CARNATION CREEK, BRITISH COLUMBIA.
Department of Fisheries and Oceans, Nanaimo (British Columbia). Fisheries Research Branch.
T. G. Brown, and G. F. Hartman.
Transactions of the American Fisheries Society TAFSAI, Vol. 117, No. 6, p 546-551, November 1988. 2 fig, 2 tab, 18 ref.

Descriptors: *Flooding, *Tributaries, *Stream biota, *Salmon, *British Columbia, *Environmental effects, Habitats, Juvenile growth stage, Storms, Watersheds, Swamps, Productivity, Migration, Water level, Fluctuations, Population dynamics.

The number of juvenile coho salmon (Oncorhynchus kisutch) were estimated using all known winter habitat sites located away from the main channel of Carnation Creek and the contributions of these habitats to the watershed's total production of coho salmon smolts were calculated. During the study period (October 1982 to June 1984), differences in the contribution were related to differences in environmental conditions. The relative importance of off-channel and main-channel habitats for winter survival of coho salmon was also assessed. Ten percent of the juvenile coho salmon rearing in the main channel of Carnation Creek during the summer moved into intermittent tributaries and ephemeral swamps (off-channel

winter habitats) during the autumn of 1983. The number of juveniles residing within specific off-channel sites during winter was governed by the magnitude of water levels associated with the first fall storms relative to the flooding levels required for adequate access to these sites ($P < 0.05$). Off-channel habitats contributed 15.3% of the watershed's coho salmon smolts in 1983 and 23.1% in 1984. A 25-year flood event (65 cu m/s) occurred in January 1984 and may have reduced the main-channel contribution for that year. The inability of coho salmon smolts to emigrate from off-channel habitats and return to the main channel in spring may have reduced the off-channel contribution in 1983. April-May water levels were 37% below the 13-year mean water level in 1983 and 55% above it in 1984. (Miller-PTT)
W89-11396

ELECTRON MICROPROBE INVESTIGATION OF THE CHEMISTRY OF FERROMANGANESE COATINGS ON FRESHWATER SEDIMENTS,
Cambridge Univ. (England). Dept. of Earth Sciences.
For primary bibliographic entry see Field 5A.
W89-11406

BENTHIC AND WEED-BED FAUNAS OF LAKE AWASA (RIFT VALLEY, ETHIOPIA),
Addis Ababa Univ. (Ethiopia). Dept. of Biology.
T. Kibret, and A. D. Harrison.
Hydrobiologia HYDRB8, Vol. 174, No. 1, p 1-15, April 1989. 2 fig, 5 tab, 29 ref.

Descriptors: *Limnology, *Benthos, *Aquatic weeds, *Lakes, *Ethiopia, Fisheries, Tilapia, Midges, Detritus, Waterfleas, Ostracods, Mollusks, Crustaceans, Tropical regions.

The community structures of the benthic and weed-bed faunas of Lake Awasa, Ethiopia Rift Valley, are described and related to the various types of substratum present. Lake Awasa is non-saline (conductivity 860 MicroS/cm), and lies in a shallow basin with maximum depths of 21-22 m. It supports an important commercial fishery mainly based on the tilapia Oreochromis niloticus. The large weed beds of the lake extend out to the 4 m isobath in most places; they consist mainly of the grass Paspalidium geminatum. Below the 6-8 m isobaths the bottom is covered with a deep layer of flocculant mud, with organic matter constituting about one third of the dry weight. No benthic animals are able to colonize this mud. In shallower regions the bottom consists of hard sand covered with a thin layer of organic detritus, except for a narrow region around the 6 m isobath where the sand is covered with a layer of ostracod shells up to 25 cm deep. All this firmer bottom is colonized by a benthic community consisting mainly of cyclopoids, ostracods, Limnodrilus and chironomids; there are no prosobranch or bivalve mollusks. The weed-bed community consists mainly of Cladocera, ostracods, Ephemeroptera, Heteroptera, chironomids and pulmonate mollusks. These communities are compared with those of other Afro-tropical lakes, and are shown to have much in common with that of Lake Chad (Dejoux, 1983), especially the chironomids (Dejoux, 1976), but Lake Awasa has fewer species, the most noticeable absentees being the decapod Crustacea. (Author's abstract)
W89-11411

CHARACTERIZATION OF ORTHOPHOSPHATE RELEASE FROM DISSOLVED ORGANIC PHOSPHORUS BY GEL FILTRATION AND SEVERAL HYDROLYTIC ENZYMES.
Hokkaido Research Inst. for Environmental Pollution, Sapporo (Japan). Div. of Water Environment.
For primary bibliographic entry see Field 7B.
W89-11413

EUTROPHICATION OF LAKE NEUCHATEL INDICATED BY THE OLIGOCHAETE COMMUNITIES.
Conservation de la Faune, Saint-Sulpice (Switzerland).
For primary bibliographic entry see Field 5C.
W89-11414

EFFECTS OF STREAM ORDER AND SEASON ON MINERALIZATION OF C(14)-PHENOL IN STREAMS.
Virginia Polytechnic Inst., Blacksburg. Dept. of Biology.
G. T. Peters, and F. S. Colwell.
Hydrobiologia HYDRB8, Vol. 174, No. 1, p 79-87, April 1989. 3 fig, 3 tab, 21 ref.

Descriptors: *Geomorphology, *Stream order, *Mineralization, *Phenols, *Microbial degradation, *Organic matter, Fluvial sediments, Streams, Detritus, Seasonal variation.

Mineralization of trace levels of C(14)-phenol by heterotrophic microorganisms was quantified at 4 sites along a river continuum in southwestern Virginia. Significant phenol mineralization rates were detected in surface sediment and seston samples at all sites from August 1985 through May 1986. Phenol degradation was strongly affected by season (ANOVA; $P<0.0001$). From a baseline rate in August (range: .0000119 to .0897 mg phenol mineralized mg/ash free dry weight (AFDW)/hr) phenol mineralization rose to a yearly maximum in October (range .000121 to .00116 mg phenol mineralized /mg AFDW/hr) despite decreasing stream temperatures. This autumnal peak in phenol degradation was attributed to the pulsed input of allochthonous detritus, especially leaf litter, which contains substantial quantities of phenols and related compounds. Although phenol mineralization was significant in these streams, phenols were metabolized at much slower rates than more labile compounds present in the dissolved organic matter (DOM) pool. Estimates of turnover rates for three major components of DOM revealed that glucose and glutamate turnover rates (0.064-0.140 hr/mg sediment AFDW and 0.140-0.610/hr/mg sediment AFDW, respectively) were, respectively, 2.2-4.7 times and 9.6-16.9 times greater than phenol turnover rates (0.015-0.064/hr/mg sediment AFDW). Although the relatively low rates of utilization of refractory phenolic materials suggest that these compounds may accumulate and become more prevalent components of the DOM pool, phenol concentrations at the 4 study sites remained below detectable levels (i.e., <1 microgram/L) throughout the study. Consequently, it seems that although phenolic materials are metabolized more slowly than labile DOM, phenols are degraded at rates which preclude accumulation in the water column. (Author's abstract)
W89-11416

CHEMICAL OXIDATION OF SULFIDE TO ELEMENTAL SULFUR: ITS POSSIBLE ROLE IN MARSH ENERGY FLOW.
Louisiana State Univ., Baton Rouge. Remote Sensing and Image Processing Lab.
J. H. Whitcomb, R. D. Delaune, and W. H. Patrick.
Marine Chemistry MRCHBD, Vol. 26, No. 3, p 205-214, April 1989. 5 fig, 24 ref. NSF Grant BSR-8414006.

Descriptors: *Wetlands, *Sulfides, *Sulfur, *Salt marshes, *Films, Oxidation, Energy transfer, Sulfates, Sediments.

Elemental sulfur was identified as the predominant material in the surface film or layer commonly observed on water surfaces in Louisiana Gulf coast brackish and salt marshes. Over 50% of the total surface area of the film consisted of elemental sulfur, emitting high levels of sulfur X-rays while the remainder of the film consisted of detritus, halite and gypsum crystals, and marine organisms such as diatoms. The elemental sulfur was amorphous, and most commonly occurred as fragmented particles and aggregates coating other film matrix material (e.g. detritus and diatoms). Samples of both formaldehyde-treated and untreated salt marsh soil-water columns both contained an appreciable amount of elemental sulfur after exposure to the atmosphere. Bacteria were not observed in the films produced in the laboratory suggesting that oxidation of sulfide occurred without the help of these organisms. Elemental sulfur formed rapidly (within 1-2 days) on the water surface when oxygen was allowed to enter the anaerobic soil-water columns, and surface tension was sufficient for it to accumulate there. Laboratory studies of sulfide oxidation showed that sulfide was rapidly removed (6-8 hr) by oxidation of interstitial water from anaerobic marsh soil. This process is hypothesized as a possible pathway for energy flow in coastal marshes. (Geiger-PTT)
W89-11425

MAJOR, MINOR AND TRACE ELEMENT DETERMINATIONS FROM A NIGERIAN AQUATIC SEDIMENT.
Ahmadu Bello Univ., Zaria (Nigeria). Center for Energy Research and Training.
For primary bibliographic entry see Field 2K.
W89-11428

REGIONAL LAKE AND RESERVOIR CANONICAL ENVIRONMENTS.
Environmental Monitoring Systems Lab., Las Vegas, NV.
K. F. Hedden, R. L. Skaggs, and J. English.
Journal of Environmental Science and Health JESEDU, Vol. 24A, No. 3, p 265-277, April 1989. 2 fig, 9 tab, 2 ref.

Descriptors: *Lakes, *Limnology, *Data collections, *Databases, *Hydrologic data collections, *Water quality, *Regional analysis, *Trophic level, Oligotrophic lakes, Eutrophic lakes, Model studies, River basins, Mathematical models, Reservoirs.

The Canonical Environments Data Base that contains selected hydrologic and water quality parameters was developed by EPA to aid in the assessment of the effects of toxic substances on the environment. This data base brings together information of each reach of the major rivers in the United States as well as individual lakes and reservoirs in those basins. Individual data on lakes and reservoirs are summarized for canonical eutrophic and oligotrophic lakes by USGS hydrologic region. Variables included in regional Canonical Environments include: lake compartment area, volume and depth; organic carbon content of sediments; total suspended solids concentration; wind speed and cloud cover; dissolved organic carbon concentration; bacteria concentration; fraction of bacteria degrading toxicant; Secchi Disc transparency; temperature; pH; chlorophyll a; density of sediments; biomass concentration; reaeration coefficient; and extinction coefficient. To facilitate the definition of aquatic canonical environments, and subsequently the application of Exposure Analysis Modeling Systems (EXAMS), a data base was developed which was composed of information that described the canonical environment of selected lakes and reservoirs within 15 major river basin systems throughout the continental United States which were part of the National Eutrophication Survey. From this large set of environmental data, appropriate components can be selected to study the transport and transformation of a specific chemical in a specific lake or reservoir using EXAMS, with some extrapolation of data in some cases. (Geiger-PTT)
W89-11429

FLUORESCENCE AND CARBON FIXATION BY PHOSPHORUS DEFICIENT PHYTOPLANKTON IN A WESTERN AUSTRALIAN RESERVOIR.
Department of Scientific and Industrial Research, Taupo (New Zealand). Taupo Research Lab.
A. B. Viner.
Archiv fuer Hydrobiologie AHYBA4, Vol. 115, No. 1, p 1-19, March 1989. 5 fig, 5 tab, 29 ref.

Descriptors: *Carbon cycle, *Phosphorus, *Limiting nutrients, *Limnology, *Australia, *Photosynthesis, *Phytoplankton, *Fluorescence, *Phosphates, Biomass, Light intensity, Lakes, Reservoirs, Nutrients, Carbon.

Photosynthetic adaptations by phytoplankton to changing irradiance were studied at an inlet of the Wellington Reservoir, near Perth. Adaptations

were measured as changing rates of carbon fixation, and of fluorescence with and without the electron transport inhibitor DCMU, under controlled laboratory light conditions. These fluorescence features were compared to those in the lake. The upper layers of the lake to c.8 m were vertically very stable but had a strong diurnal horizontal advection pattern which transported the phytoplankton in and out of the inlet, exposing algae to sustained high light intensities in the uppermost 2 m. However, changes during 1 hour or less in fluorescence could be induced that were consistent with phytoplankton adaptation to irradiances less than those in the top 2 m and more characteristic of those at 5 m or below. This occurrence indicates that some vertical transport from lower to uppermost layers was probably taking place within the time span of the fluorescence changes. Phytoplankton biomass in the lake was apparently limited by the available phosphorus. Phosphate nutrient enrichment in the laboratory affected fluorescence yield, and although fertilizing the lake with phosphate during 6 days was insufficient to promote detectable increased biomass, it did increase the ability of the phytoplankton to adjust photosynthetic rate to light intensity and to raise the optimum irradiance for photosynthesis. The large changes in carbon fixation and fluorescence induced in the laboratory were much muted in situ, suggesting that vertical movement was fast enough, relative to rate of adaptation, to smooth fluorescence distinctions between depths and to promote a rather uniform light state in the algae, in addition to probable endogenous rhythmic changes present. (Author's abstract)
W89-11438

INFLUENCE OF A PERIPHYTIC BIOLAYER ON PHOSPHORUS EXCHANGE BETWEEN SUBSTRATE AND WATER,
Lund Univ. (Sweden). Limnological Inst.
L. Hansson.
Archiv fuer Hydrobiologie AHYBA4, Vol. 115, No. 1, p 21-26, March 1989. 1 fig, 2 tab, 15 ref.

Descriptors: *Phosphorus, *Sediment-water interfaces, *Aquatic plants, *Limnology, *Cycling nutrients, Nutrients, Periphyton.

The impact of a periphytic biolayer on the substrate, the overlying water and the transport of nutrients between substrate and water was studied in a laboratory experiment. The phosphorus content of both sediment and water were lower in aquaria with periphytic biolayers. In the experimental aquaria approximately the same amount of phosphorus was found in the biolayers that disappeared from the sediments, indicating that the periphyton used the phosphorus from the sediment. In addition, only small amounts of phosphorus were released to the water in the presence of periphyton. Hence, the distribution of phosphorus differed significantly between aquaria with and without periphyton. Since the abiotic factors known to influence nutrient transport (pH, redox potential) were constant, this study points out the flux of phosphorus between sediment and water. However, the results may not be quantitatively transferred to natural conditions, but should be viewed as a demonstration of a possible mechanism. (White-Reimer-PTT)
W89-11439

INFLUENCE OF CATCHMENT GEOLOGY AND LAKE DEPTH ON PHYTOPLANKTON BIOMASS,
Kinneret Limnological Lab., Tiberias (Israel).
C. M. Duarte, and J. Kalff.
Archiv fuer Hydrobiologie AHYBA4, Vol. 115, No. 1, p 27-47, March 1989. 4 fig, 3 tab, 47 ref.

Descriptors: *Lake basins, *Water depth, *Limnology, *Lake morphometry, *Lakes, *Phytoplankton, *Geomorphology, Biomass, Chlorophylla, Statistical analysis, Phosphorus, Correlation analysis, Eutrophication.

The relationship between the geographic characteristics of lakes (i.e. lake morphometry, catchment characteristics, and climate) and lake water chemistry and phytoplankton biomass for 215 temperate zone North American lakes is examined. The data used was compiled for the North American OECD eutrophication projects and supplemented with additional data sets to both extend the range of the variables and to balance the geographical distribution. Due to the wide range in all variables, logarithmic transformation was required to normalize data distributions and to stabilize their variances for analysis of variance and for correlation and regression analyses. Catchment geology was shown to be an important determinant of lake chemistry. Catchment geology and mean depth together describe phytoplankton biomass almost as well as does the total phosphorus concentration. Furthermore, catchment geology and mean depth influence the chlorophyll-a yield for a given phosphorus concentration, emphasizing the importance of geographic conditions on lake trophic status. (White-Reimer-PTT)
W89-11440

TIME DEPENDENT RESPONSE OF LAKE KINNERET TO AN APPLIED WIND STRESS AND HYDRAULIC FLOW: ADVECTION OF SUSPENDED MATTER,
Kinneret Limnological Lab., Tiberias (Israel).
G. Herman.
Archiv fuer Hydrobiologie AHYBA4, Vol. 115, No. 1, p 41-57, March 1989. 10 fig, 18 ref, 1 append.

Descriptors: *Hydrodynamics, *Wind-driven currents, *Advection, *Limnology, *Hydraulic models, *Lakes, *Suspended sediments, *Lake Kinneret, Wind, Coriolis force, Flow pattern, Jordan River, Model studies.

The two-dimensional, vertically integrated steady state circulation model which was applied to Lake Kinneret was extended to include the time dependent response. The same homogeneous winter conditions were assumed. It was found that under calm conditions, the Jordan flow pattern was strongly perturbed by the Coriolis force and locally by the withdrawal through the National Water Carrier. The circulation pattern established by a uniform wind stress (0.065 N/ sq m) was found to be about two orders of magnitude larger than the Jordan flow, so that at least three days between wind events was required before the Jordan flow could be discerned. The circulation model was used in conjunction with an advection routine to compute the horizontal distribution of matter subjected to a uniform summer westerly wind and winter SE wind. It was found that under the latter conditions, the resulting water column concentrations of suspended matter closely resembled measured sediment concentrations. In addition, using a free-surface model, oscillations of the surface elevation were computed. (Author's abstract)
W89-11441

IRON OXIDE PARTICULATES FORMED BY THE OXYGENATION OF NATURAL AND MODEL LAKEWATERS CONTAINING FE(II).
Freshwater Biological Association, Ambleside (England).
E. Tipping, D. W. Thompson, and C. Woof.
Archiv fuer Hydrobiologie AHYBA4, Vol. 115, No. 1, p 59-70, March 1989. 4 fig, 2 tab, 22 ref.

Descriptors: *Sedimentation, *Limnology, *Water chemistry, *Particulate matter, *Lakes, *Iron oxides, *Oxygenation, Hydrogen ion concentration, Silica, Calcium.

Most of the iron oxide precipitated in Esthwaite (Cumbria, England), during summer stratification and deep-water anoxia, consists of ferrihydrite in the form of spheres, ellipsoids or rods of average dimension >0.2 micrometers (referred to as 'large particles'). By suspending the oxide at different pH values and measuring solution concentrations of Ca(2+), inorganic phosphate and organic matter, it was found that most of each of these components can be released from the oxide without affecting particle morphology. However, little release of Si could be induced. Oxygenation experiments with model lakewaters initially containing Fe(II) confirmed the previous findings that the presence of Si(OH)4 leads to the formation of ferrihydrite, otherwise the oxidation product is lepidocrocite. The model lakewaters did not yield 'large particles', instead the material consisted of small units a few nm in diameter. Oxygenation experiments with filtered (0.22 micrometers) and unfiltered natural waters showed that the formation of 'large particles' requires the presence of natural particulate matter. However, biological poisons (azide, formalin) did not affect particle formation, which suggests that living organisms are not involved. (Author's abstract)
W89-11442

INFLUENCE OF ARTIFICIAL STREAM BOTTOM SILTATION ON EPHEMEROPTERA IN EMERGENCE TRAPS,
Max-Planck-Inst. fuer Limnologie, Schlitz (Germany, F.R.). Limnologische Flussstation.
R. Wagner.
Archiv fuer Hydrobiologie AHYBA4, Vol. 115, No. 1, p 71080, March 1989. 2 fig, 3 tab, 21 ref.

Descriptors: *Bottom sediments, *Ecological distribution, *Limnology, *Aquatic insects, *Benthic environment, *Mayflies, *Stream biota, Niches, Species diversity, Competition, Habitats, West Germany, Population density, Statistical analysis, Sedimentation, Weirs, Larvae, Biomass.

An in-situ experiment was initiated to evaluate the influence of artificial stream bottom sedimentation on the may-fly biocenosis of the Breitenbach (Hesse, FRG). Ephemeroptera were caught in two adjacent emergence traps, one with an artificially sedimented stream bottom, the other remained unchanged. During the investigation period (1981-1984) the following changes in species abundance were observed: there was an extremely significant decrease in specimen numbers of both Baetis species over the sedimented stretch. B. vernus dropped to 16.2-26.8% and B. rhodani to 1.3-20.4% of abundance in the control area. A statistically significant change in the abundance of both Ephemerella species was not observed. On the other hand Paraleptophlebia submarginata and Centroptilum luteolum showed marked increases in specimen numbers. Abundance of Habrophlebia fusca also increased over the sedimented stretch, but specimen numbers were too low for statistical treatment. Physicochemical factors cannot be considered the cause of these changes. Direct observation of larvae revealed interspecific differences in behavior on individual sediment fractions. Biomass over the sedimented area was only 8-50% of the control stretch. The similarity index described significant differences between both taxocenoses more clearly than diversity or evenness indices. (White-Reimer-PTT)
W89-11443

LEACHING KINETICS OF FRESH LEAF-LITTER WITH IMPLICATIONS FOR THE CURRENT CONCEPT OF LEAF-PROCESSING IN STREAMS.
Konstanz Univ. (Germany, F.R.). Limnological Inst.
M. W. Gessner, and J. Schwoerbel.
Archiv fuer Hydrobiologie AHYBA4, Vol. 115, No. 1, p 81-90, March 1989. 2 fig, 46 ref.

Descriptors: *Lotic environment, *Litter, Aquatic environment, Aquatic productivity, *Riparian vegetation, *Detritus, *Decomposing organic matter, Willow, Alder, *Leaves, Nutrition.

In leaching experiments autumn-shed leaves of Alnus glutinosa (L.) Gaertn. and Salix fragilis L. did not exhibit notable mass losses over a period of several days when fresh, i.e. non-dried material was used. These findings contrast sharply with the behavior of pre-dried foliage. For, as is generally accepted and was confirmed by the present investigation, pre-dried leaves lose a considerable portion of their soluble compounds (up to 33% of total dry-mass) within 24 hours after immersion in water. Because the bulk of autumn-shed leaves of alder, willow, and other riparian tree species enters streams in a fresh state, dramatic leaching is not likely to occur immediately after input of the leaves to the stream bed. Therefore, under natural

circumstances, newly entrained leaf-litter probably has a much better nutritional value than is generally assumed. The improved nutritional quality of the leaves may in turn affect subsequent stages of decomposition. It may be expected that conditioning is not necessary for attracting large-particle detritivores to the litter. However, factors like the non-reduced phenol content of fresh leaves, a possibly insurmountable cuticle, and functioning defense mechanisms of the intact tissue may offset the profit brought about by the retention of easily degradable resources. (Author's abstract)
W89-11444

EXPERIMENTAL STUDY OF ZOOPLANKTON CONSUMPTION BY THE LAKE KINNERET SARDINE.
Kinneret Limnological Lab., Tiberias (Israel).
M. Gophen, and S. Threlkeld.
Archiv fuer Hydrobiologie AHYBA4, Vol. 115, No. 1, p 91-95, March 1989. 1 tab, 17 ref.

Descriptors: *Feeding rates, *Limnology, *Zooplankton, *Fish food organisms, *Sardines, Israel, Aquatic populations, Plankton, Phosphorus, Lake Kinneret, Food habits, Food chains, Waterfleas.

The feeding habits of the Lake Kinneret sardine (Mirogrex terraesanctae terraesanctae) were studied in tanks containing lake zooplankton. Zooplankton abundance in the experimental tanks decreased by 65-95% compared to 3-15 % in the control tanks during each 24 hour feeding rate assessment. From one day to the next there was no clear pattern of how Mirogrex feeding rate would change. Electivity for Diaphanosoma varied significantly among tanks, although the feeding rate constant did not vary significantly among tanks for Diaphanosoma or any other prey. The sardine did feed preferentially on the large-bodied cladocerans Diaphanosoma brachyurum and Ceriodaphnia reticulata. Due to this preferential feeding, the size composition of the zooplankton has shifted toward smaller organism, and smaller individuals within each population. Since the larger zooplankton are believed to help control nanoplankton, this trophic change may be significant. If 11% of the ingested zooplankton biomass is defecated and recycled by lower trophic levels of the Lake Dinneret food web, Mirogrex are potentially important as sources of phosphorus, which is normally limiting to phytoplankton in Lake Kinneret (White-Reimer-PTT)
W89-11445

HORIZONTAL DISTRIBUTION OF ROTIFER PLANKTON ALONG A TROPHIC GRADIENT IN LAKE BALATON: CHANGES OF COMMUNITY STRUCTURE AND ABUNDANCE DURING THE PAST 20 YEARS.
Balatoni Limnologiai Kutato Intezete, Tihany (Hungary).
N. P. Zankai.
Archiv fuer Hydrobiologie AHYBA4, Vol. 115, No. 1, p 111-123, March 1989. 7 fig, 2 tab, 29 ref.

Descriptors: *Distribution patterns, *Population density, *Limnology, *Water pollution effects, *Environmental gradient, *Species composition, *Rotifers, *Zooplankton, Eutrophication, Hungary, Lake Balaton, Population dynamics.

The density of rotifers in plankton in areas of varying trophy in Lake Balaton was studied in 1984-1985. The number of rotifers averaged 10 times higher in lake areas showing high primary production as compared to oligo-mesotrophic areas. Keratella cochlearis, K. cochlearis tecta, K. quadrata, Kellicottia longispina, and Polyarthra spp. were collected from the whole lake area at all times. Proalides tentaculatus and Liliferotrocha subtilis were abundant in summer in eu-hypertrophic areas, constituting 80-90% of the Rotatoria stock. These, as well as Trichocerca pusilla and the Synchaeta spp. were characteristic of highly eutrophic waters, while Brachionus urceolaris sessilis, Collotheca balatonica, and Pompholyx spp. were consistently found only in oligo-mesotrophic lake areas. During the past 20 years, the composition of the Rotatoria plankton changed considerably in the hypertrophic lake areas, showing a 10-fold increase in abundance. In areas of low trophy, rotifer community structure changed to a lesser extent and the density remained constant. (Author's abstract)
W89-11446

CYCLESTHERIA HISLOPI (BAIRD, 1895) (BRANCHIOPODA: CONCHOSTRACA) IN YEWA RIVER, NIGERIA.
Benin Univ., Benin City (Nigeria). Dept. of Zoology.
A. B. M. Egborge, and N. Ozoro.
Archiv fuer Hydrobiologie AHYBA4, Vol. 115, No. 1, p 137-148, March 1989. 19 fig, 3 tab, 13 ref.

Descriptors: *Water hyacinth, *Brackish water, *Crustaceans, *Nigeria, Yewa River, Seasonal distribution, Spatial distribution, Branchiopoda, Salinity, Clam shrimps.

Qualitative investigations of the fauna associated with Eichhornia crassipes, the water hyacinth, revealed the presence of Cyclestheria hislopi in Nigeria's Yewa River. This river which is predominantly fresh for nine months of the year becomes slightly brackish from March to May, a phenomenon associated with both the pattern of rainfall and the influence of the Atlantic Ocean. During the rainy season months when freshwaters predominate, transparencies are low. There is evidence to suggest that the spatial distribution of the conchostracan is salinity related. Also the data revealed that fecundity, rostral serration and post-abdominal spine development generally are size related and so morphological variability in conchostracans of the same species and size could be a useful taxonomic feature. (Author's abstract)
W89-11448

PHYSIOLOGICAL STATE OF EPIPHYTIC BACTERIA ON SUBMERGED STEMS OF THE REED PHRAGMITES AUSTRALIS COMPARED WITH PLANKTONIC BACTERIA IN GRAVEL-PIT PONDS.
Hull Univ. (England). Dept. of Applied Biology.
S. A. Al-Hadithi, and R. Goulder.
Journal of Applied Bacteriology JABAA4, Vol. 66, No. 2, p 107-117, July 1988. 1 fig, 4 tab, 47 ref.

Descriptors: *Physiological ecology, *Limnology, *Aquatic bacteria, *Bacterial physiology, *Plankton, *Phragmites, *Epiphytes, Aquatic plants, Gravel pits, Ponds, Nutrients.

Suspensions of epiphytic bacteria from submerged stems of Phragmites australis, collected from a gravel-pit pond, were prepared by treatment in a stomacher and by brushing. The two procedures were equally successful in dislodging bacteria. These epiphytic bacteria were compared with planktonic bacteria in water samples from within the reed bed. Colony-forming units (cfu) as a percentage of acridine-orange direct counts (AODCs), percentage of cells capable of intracellular reduction of 2-(p-iodophenyl)-5-phenyl tetrazolium chloride (INT) to INT-formazan, percentage of cells able to form microcolonies, and cell length were all greater for epiphytic bacteria. Epiphytic bacteria of P. australis from six further gravel-pit ponds were also compared with bacterioplankton; colony-forming units as a percentage of acridine-orange direct counts, and percentage of cells capable of INT reduction were again greater for epiphytic bacteria. Because the epiphytic bacteria in these non-organically-enriched, gravel-pit ponds were physiologically different from the planktonic bacteria it is suggested that there was not continual casual exchange, by largely identical bacterial cells, between the epiphytic and planktonic mode. Instead, epiphytic and planktonic populations were independent of each other and/or if there was exchange then bacteria were more successful while in the attached mode, perhaps because of greater organic-nutrient availability at the stem surface. (Author's abstract)
W89-11463

HYPOLIMNETIC CONCENTRATIONS OF DISSOLVED OXYGEN, NUTRIENTS, AND TRACE ELEMENTS IN COEUR D'ALENE LAKE IDAHO.
Geological Survey, Boise, ID. Water Resources Div.
For primary bibliographic entry see Field 5B.
W89-11478

LOWER LETHAL TEMPERATURES FOR CARP (CYPRINUS CARPIO L.) AND THE PHYTOPHAGOUS FISHES (CTENOPHARYNGODON IDELLA VAL., HYPOPHTHALMICHTHYS MOLITRIX VAL., ARISTICHTHYS NOBILIS RICH.) IN THE FIRST PERIOD OF LIFE (DOLNE LETALNE TEMPERATURY DLA KARPIA (CYPRINUS CARPIO) I RYB ROSLINOZERNYCH (CTENOPHARYNGODON IDELLA VAL., HYPOPHTHALMICHTHYS MOLITRIX VAL., ARISTICHTHYS NOBILIS RICH.) W PIERWSZYM OKRESIE ZYCIA).
Instytut Rybactwa Srodladowego, Olsztyn-Kortowo (Poland).
A. Lirski, and K. Opuszynski.
Roczniki Nauk Rolniczych, Seria H: Rybacwo RNRRB9, Vol. 101, No. 4, p 11-29, 1988. 11 fig, 3 tab, 22 ref. English summary.

Descriptors: *Carp, *Temperature effects, *Mortality, *Cooling, *Fish management, Fish, Adaptation, Water temperature, Growth, Growth stages, Larval growth stage, Fish stocking, Seasonal variation.

Lethal temperatures for fish 3-46 days old were studied during four seasons in Poland. Water temperature was lowered at a rate of 0.1 C. Individual responses did not differ much, although some variation was observed in different seasons and between the tests. Fish resistance to low temperatures was found to increase with fish age and size. It was calculated that lower lethal temperatures for the youngest fish should not exceed 14 C for carp and 16-17 C for phytophagous fishes. Studies on fish response to being kept in cool water revealed that younger fishes were able to support low temperature longer than the older ones. The youngest fishes underwent a shock in higher temperature but were able to survive it, while older fishes underwent a shock in lower temperature and were not able to survive it. These studies suggest that no increased resistance to low temperatures can be expected as regards stocking material of carp and the phytophagous fishes aged 2-3 weeks. (Author's abstract)
W89-11494

UPPER LETHAL TEMPERATURES FOR CARP (CYPRINUS CARPIO L.) AND THE PHYTOPHAGOUS FISHES (CTENOPHARYNGODON IDELLA VAL., HYPOPHTHALMICHTHYS MOLITRIX VAL., ARISTICHTHYS NOBILIS RICH.) IN THE FIRST PERIOD OF LIFE (GORNE LETALNE TEMPERATURY DLA KARPIA (CYPRINUS CARPIO L.) I RYB ROSLINOZERNYCH (CTENOPHARYNGODON IDELLA VAL., HYPOPHTHALMICHTHYS MOLITRIX VAL., ARISTICHTHYS NOBILIS RICH.) W PIERWSZYM OKRESIE ZYCIA).
Instytut Rybactwa Srodladowego, Olsztyn-Kortowo (Poland).
A. Lirski, and K. Opuszynski.
Roczniki Nauk Rolniczych, Seria H: Rybactwo RNRRB9, Vol. 101, No. 4, p 31-49, 1988. 5 fig, 5 tab, 45 ref. English summary.

Descriptors: *Carp, *Temperature effects, *Heat resistance, *Fish management, Seasonal variation, Fish, Adaptation, Water temperature, Growth stages, Juvenile growth stage, Mortality.

Lethal temperatures were studied for three seasons in fish aged 3-50 days. Variability of individual responses to high temperatures was not high. No differences were observed in particular seasons. Considerable changes were noted in lethal temperatures between tests. No dependence was found between fish weight and lethal temperature. A slight increase of the lethal temperature along with fish age was observed for carp and silver carp, whereas in case of grass carp the trend was opposite. Changes of the lethal temperatures with fish age were too small to be of any practical signifi-

cance. Final upper lethal temperatures were similar for all fish species under study, being within a range of 43-44 C. (Author's abstract)
W89-11495

THRESHOLD OXYGEN CONTENT IN WATER FOR JUVENILE STAGES OF THE CYPRINIDS (CTENOPHARYNGODON IDELLA VAL., HYPOPHTHALMICHTHYS MOLITRIX VAL., ARISTICHTHYS NOBILIS RICH., CYPRINUS CARPIO L.) (PROGOWA ZAWARTOSC TLENU W WODZIE DLA MLODOCIANYCH STADIOW RYB KARPIOWATYCH (CTENOPHARYNGODON IDELLA VAL., HYPOPHTHALMICHTHYS MOLITRIX VAL., ARISTICHTHYS NOBILIS RICH., CYPRINUS CARPIO L.)).
Instytut Rybactwa Srodladowego, Olsztyn-Kortowo (Poland).
M. Wozniewski, and K. Opuszynski.
Roczniki Nauk Rolniczych, Seria H: Rybactwo RNRRB9, Vol. 101, No. 4, p 51-59, 1988. 4 fig, 16 ref. English summary.

Descriptors: *Carp, *Oxygen requirements, *Mortality, *Fish management, Fish, Oxygen, Growth stages, Larval growth stage.

Lethal threshold concentrations of oxygen were determined for the larvae of Asian fishes acclimated in Poland: grass carp, silver carp, and bullhead carp, as well as for common carp. Lethal oxygen levels were determined in vessels filled with water containing constant low concentrations of oxygen. The tests lasted for 30 min. Ten fish were tested in each test. Lethal oxygen concentrations, resulting in 50% mortality, were determined. All tests were performed in 25 C. It was found that the phytophagous fish were less resistant to low oxygen levels in the first days of life than common carp. After 10-14 days of life, lethal oxygen concentration was similar for all fish, amounting to less than 1 mg O2/L. The most noticeable increase of the resistance to low oxygen content in water took place in the larval stage, up to individual fish weight of about 20 mg for the phytophagous fishes, and 30 mg for carp. It can be assumed that the threshold oxygen levels can constitute a criterium for estimating the quality of larvae. (Author's abstract)
W89-11496

TOLERANCE OF OXYGEN DEFICIT BY ELVERS (ANGUILLA ANGUILLA L.) (TOLERANCE AU DEFICIT D'OXYGENE CHEZ LA CIVELLE (ANGUILLA ANGUILLA L.)).
Ecole Nationale Superieure Agronomique de Toulouse (France). Lab. d'Ichthyologie Appliquee.
For primary bibliographic entry see Field 5C.
W89-11501

THERMAL AND WATER SOURCE EFFECTS UPON THE STABILITY OF ENTEROVIRUSES IN SURFACE FRESHWATERS.
Environmental Protection Agency, Cincinnati, OH.
For primary bibliographic entry see Field 5B.
W89-11506

MICROZONATION OF DENITRIFICATION ACTIVITY IN STREAM SEDIMENTS AS STUDIED WITH A COMBINED OXYGEN AND NITROUS OXIDE MICROSENSOR.
Aarhus Univ. (Denmark). Inst. of Ecology and Genetics.
P. B. Christensen, L. P. Nielsen, N. P. Revsbech, and J. Sorensen.
Applied and Environmental Microbiology AEMIDF, Vol. 55, No. 5, p 1234-1241, May 1989. 4 fig, 41 ref.

Descriptors: *Fate of pollutants, *Denitrification, *Sediments, *Measuring instruments, *Oxygen, *Streams, Nitrates, Electrodes, Distribution.

Microzonation of denitrification was studied in stream sediments by a combined O2 and N2O microsensor technique. O2 and N2O concentration profiles were recorded simultaneously in intact sediment cores in which C2H2 was added to inhibit N2O reduction in denitrification. The N2O profiles were used to obtain high-resolution profiles of denitrification activity and nitrate distribution in the sediments. O2 penetrated about 1 mm into the dark-incubated sediments, and denitrification was largely restricted to a thin anoxic layer immediately below that. With 115 microM nitrate in the water phase, denitrification was limited to a narrow zone from 0.7 to 1.4 mm in depth, and total activity was 34 nmol of N/sq cm/h. With 1,250 microM nitrate in the water, the denitrification zone was extended to a layer from 0.9 to 4.8 mm in depth, and total activity increased to 124 nmol of N/sq cm/h. Within most of the activity zone, denitrification was not dependent on the nitrate concentration and the apparent K sub m for nitrate was less than 10 microM. Denitrification was the only nitrate-consuming process in the dark-incubated stream sediment. Even in the presence of C2H2, a significant N2O reduction (up to 30% of the total N2O production) occurred in the reduced, nitrate-free layers below the denitrification zone. This effect must be corrected for during use of the conventional C2H2 inhibition technique. (Author's abstract)
W89-11511

METAL INTERACTIONS WITH MICROBIAL BIOFILMS IN ACIDIC AND NEUTRAL PH ENVIRONMENTS.
University of Western Ontario, London. Dept. of Geology.
For primary bibliographic entry see Field 2K.
W89-11512

DETAILED ORGANIC CARBON BUDGET AS AN ECOSYSTEM-LEVEL CALIBRATION OF BACTERIAL RESPIRATION IN AN OLIGOTROPHIC LAKE DURING MIDSUMMER.
New York Botanical Garden, Bronx, NY. Inst. of Ecosystem Studies.
J. J. Cole, N. F. Caraco, D. L. Strayer, C. Ochs, and S. Nolan.
Limnology and Oceanography LIOCAH, Vol. 34, No. 2, p 286-296, March 1989. 4 fig, 3 tab, 45 ref. NSF Grant BRS 85-16987.

Descriptors: *Physiological ecology, *Limnology, *Carbon cycle, *Organic carbon, *Bacterial physiology, *Respiration, *Oligotrophic lakes, Lakes, Seasonal variation, Calibrations, Stratification, New Hampshire, Epilimnion, Productivity, Growth, Zooplankton, Flagellates.

Intensive measurements of the major inputs and outputs of organic carbon to and from the epilimnetic water column of oligotrophic Mirror Lake, NH were made during a one-month period at the peak of summer stratification. On the basis of the difference between all other inputs and outputs, bacterial respiration must lie between 0.4 and 6 mmol C/sq m/d. With measured rates of thymidine incorporation and measured bacterial cell sizes, this organic C budget constrains the thymidine conversion factor to be between 1 and 6 x 10 to the 9th power cells per nM thymidine for growth yields between 10% and 80%. On the basis of the best estimates for all parameters, bacterial production was equal to 16% of primary production and bacterial respiration was about 40% as large as the respiration of macrozooplankton. The respiration of nanoflagellate microzooplankton was < 10% as large as the respiration of macrozooplankton and could account for the remineralization of only 25% of bacterial production. (Author's abstract)
W89-11514

BACTERIAL ACTIVITY AND PROTOZOAN-GRAZING POTENTIAL IN A STRATIFIED LAKE.
Limnologisch Inst., Nieuwersluis (Netherlands).
J. Bloem, and M.-J. B. Bar-Gilissen.
Limnology and Oceanography LIOCAH, Vol. 34, No. 2, p 297-309, March 1989. 6 fig, 2 tab, 50 ref.

Descriptors: *Limnology, *Aquatic bacteria, *Protozoa, *Stratification, Productivity, Lake Vechten, Lakes, Bacteria, Oxygen, Flagellates, Cyanophyta, Algae, Growth, The Netherlands.

During summer stratification in Lake Vechten, The Netherlands, heterotrophic nanoflagellates (HNAN) showed peak densities at very low oxygen concentrations in the lower metalimnion at a depth of 6-7 m. In this stratum, high HNAN numbers (> 30 million HNAN/l) coincided with high bacterial activity. Assuming a conversion factor of 2 x 10 to the 18th power bacteria/mol thymidine, a maximal bacterial production of about 4 x 10 to the 9th power bacteria/l/d from thymidine incorporation was estimated. In the upper metalimnion (5-6 m depth), a low bacterial activity (estimated production 1 x 10 to the 8th power bacteria/l/d) and low HNAN numbers (3 million HNAN/l) were found. HNAN seem to be a link in the food web between bacteria and cyanobacteria on the one hand and ciliates on the other. Grazing experiments with selectively filtered lake water indicated ingestion rates of about 7 bacteria/HNAN/h. It was calculated that the metalimnetic HNAN are able to consume the entire bacterial production even at high bacterial growth rates. (Author's abstract)
W89-11515

INTERANNUAL FLUCTUATIONS IN PRIMARY PRODUCTION: METEOROLOGICAL FORCING AT TWO SUBALPINE LAKES.
California Univ., Davis. Div. of Environmental Studies.
C. R. Goldman, A. Jassby, and T. Powell.
Limnology and Oceanography LIOCAH, Vol. 34, No. 2, p 310-323, March 1989. 8 fig, 1 tab, 53 ref. NSF Grant BSR 87-05170; US EPA Cooperative Agreement CR814581.

Descriptors: *Weather, *Mountain lakes, *Limnology, *Primary productivity, Annual distribution, California, Snow, Snowpack, Precipitation, Thaw, Climatology, Forecasting.

Meteorological factors are associated with most of the interannual variability in primary production at both Castle Lake, CA (41 deg N, 122 deg W) and Lake Tahoe, CA-NV (39 deg N, 120 deg W). At Castle Lake, extreme values of annual primary production, either much higher or lower than the long-term average, are likely to occur during the phenomenon of El Ninos/Southern Oscillation. Two plausible pathways for the impacts of these large-scale climate events at Castle Lake were identified: winter snowfall, acting through its effect on the snow-ice pack and the timing of the spring thaw; and total precipitation, acting through its effect on outwash rates. In contrast, no influence of large-scale climate events is apparent at Lake Tahoe, but a plausible pathway involving the impact of synoptic-scale phenomena on interannual variation was identified: local weather events occurring in the late winter-early spring period near the time of minimal stratification, acting through their effect on the depth of spring mixing. The difference between the two lakes can be attributed to absence of an ice cover and long hydraulic retention time at Lake Tahoe. Time-series models that incorporate meteorological information adequately forecast primary production at both lakes. (Author's abstract)
W89-11516

PHOSPHORUS-DEPENDENT GROWTH KINETICS OF 11 SPECIES OF FRESHWATER ALGAE.
Minnesota Univ., Minneapolis. Dept. of Ecology and Behavioral Biology.
J. P. Grover.
Limnology and Oceanography LIOCAH, Vol. 34, No. 2, p 341-348, March 1989. 1 fig, 2 tab, 48 ref. NSF Grant BSR 81-143202.

Descriptors: *Limnology, *Phosphorus, *Growth kinetics, *Algae, Culturing techniques, Nutrients, Nitzschia, Diatoms, Chlamydomonas.

Mixed-species batch cultures were used to measure kinetics of phosphorus-dependent growth for 11 species of freshwater algae. Results were fitted to the Monod model, and significant interspecific differences were found. Indices of competitive ability calculated from the Monod parameters suggest

that Synedra radians, Synedra rumpens, Nitzschia acicularis, and Chlamydomonas sp. are good competitors for P, and that Nitzschia palea and several nonsiliceous algae are poor competitors for P. These indices of competitive ability are largely consistent with competitive outcomes in a companion experiment with these species and with other studies. No relation was found between maximal growth rate and the effect that fluctuations in P supply had on a species' performance in the competition experiment. Growth parameters and competitive indices were not significantly correlated with cell volume, surface area, or surface:volume ratio. (Author's abstract)
W89-11518

EFFECTS OF SI:P SUPPLY RATIO, SUPPLY VARIABILITY, AND SELECTIVE GRAZING IN THE PLANKTON: AN EXPERIMENT WITH A NATURAL ALGAL AND PROTISTAN ASSEMBLAGE.
Minnesota Univ., Minneapolis. Dept. of Ecology and Behavioral Biology.
J. P. Grover.
Limnology and Oceanography LIOCAH, Vol. 34, No. 2, p 349-367, March 1989. 7 fig, 7 tab, 37 ref. NSF Grant BSR 81-143202.

Descriptors: *Physiological ecology, *Eutrophication, *Limnology, *Silicon, *Phosphorus, *Plankton, *Algae, *Bacteria, Culturing techniques, Chlorophyta, Diatoms, Chrysophyta, Nutrients, Ecology, Lakes.

Semicontinuous cultures were used to examine the effects of Si and P supply on a natural algal community. The Si:P ratio had a strong effect on the species composition of the algae. Chlorophytes were most abundant at the low Si:P supply ratio (20:1), diatoms were most abundant at the intermediate Si:P supply ratio (80:1), and the siliceous chrysophyte Mallomonas sp. was most abundant at the high Si:P supply ratio (160:1). Diatom species showed differentiation in their ability to compete for Si and P. On average, algal cells became smaller as the Si:P supply ratio decreased. Higher algal species richness was associated with increased variability in P supply. Competitive ability of some algae was increased by variability in P supply, but that of others was decreased. A flagellated protist grazed selectively on two Nitzschia spp., and thereby altered their competitive dynamics. The biovolume of this protist, and that of other heterotrophic flagellates, decreased with increasing variability in P supply. Despite selective grazing and nutrient supply variability, patterns in the algal communities were generally consistent with expectations based on resource competition theory and previous experience with algal competition in cultures. (Author's abstract)
W89-11519

MULTIVARIATE STATISTICAL ANALYSIS OF THE FACTORS CONTROLLING THE DISTRIBUTION OF SCALED CHRYSOPHYTES.
Western Connecticut State Univ., Danbury. Dept. of Biological and Environmental Sciences.
P. A. Siver, and J. S. Hamer.
Limnology and Oceanography LIOCAH, Vol. 34, No. 2, p 368-381, March 1989. 6 fig, 7 tab, 44 ref. US DOI Grant 14-08-0001-G1412-04.

Descriptors: *Chrysophyta, *Limnology, *Ecological distribution, Algae, Multivariate analysis, Electron microscopy, Acidity, Conductance, Temperature, Phosphorus, Hydrogen ion concentration.

A total of 332 collections from 62 water bodies was analyzed for scaled chrysophytes with electron microscopy and correlated with limnological characteristics. The pH and specific conductance were the most important factors controlling the distribution of scaled chrysophytes; temperature and total phosphorus were of lesser importance. A mean of nine and seven taxa per collection were recorded at a pH of 5.5-6.0 and a specific conductance of < 40 microS, respectively. Significantly fewer taxa per collection were found as the pH lowered below 5.5 or raised above 6.0 or as the specific conductance increased above 40 microS. Similar distributional patterns were found for the genera Mallomonas, Synura, and Spiniferomonas. A two-factor principal component model explained 70% of the total variance within the data set (n = 1,355). The first principal component explained 80 and 83% of the total variance within the pH and specific conductance variables. The pH and specific conductance also dominated the first principal component for each genus and for 23 of the 25 species tested. A cluster analysis, using within-group linkages, produced five groups of organisms that differed primarily with respect to their distribution along a pH gradient. (Author's abstract)
W89-11520

ZOOPLANKTON ABUNDANCE IN THE LOWER ORINOCO RIVER, VENEZUELA.
Colorado Univ. at Boulder. Center for Limnology.
J. F. Saunders, and W. M. Lewis.
Limnology and Oceanography LIOCAH, Vol. 34, No. 2, p 397-409, March 1989. 4 fig, 5 tab, 44 ref. NSF Grants DEB 81-6725, BSR 83-15410, BSR 86-04655.

Descriptors: *Zooplankton, *Orinoco River, *Population density, *Venezuela, Tributaries, Rotifers, Aquatic animals, Copepods, Crustaceans, Waterfleas, Distribution, Ecology, Zooplankton, Plankton, Flood plains, Food chains, Flooding.

Zooplankton were sampled quantitatively in the lower Orinoco River and three major tributaries (Apure, Caura, Caroni). Dominant taxa were euplanktonic, which suggests origin from standing waters. In the Orinoco, densities for rotifers (mean 7.6 ind/l) were greater than those for cladocerans (0.9 ind/l) or copepods (1.2 ind/l), but cladocerans accounted for more than half of total biomass (0.5 micrograms C/l). Average tributary contributions to zooplankton transport in the lower Orinoco (873 kg/C/d) were proportional to their average discharges. Extensive fringing floodplain along the lower Orinoco contributed very little to total transport. At low water on the Orinoco, when there was no contact with the floodplain, the transport of copepods (mainly nauplii) and Bosmina increased downstream by more than could be ascribed to additions from the tributaries or to reproduction in transit. These zooplankton appear to originate along the river margin, within the channel, and are probably significant as an energy input for food webs in the channel and as an inoculum to floodplain habitats at the time of inundation. (Author's abstract)
W89-11521

DYNAMICS OF HORIZONTAL TURBULENT MIXING IN A NEARSHORE ZONE OF LAKE GENEVA.
Ecole Polytechnique Federale de Lausanne (Switzerland). Lab. d'Hydraulique.
U. Lemmin.
Limnology and Oceanography LIOCAH, Vol. 34, No. 2, p 420-434, March 1989. 9 fig, 3 tab, 19 ref.

Descriptors: *Nearshore processes, *Hydrodynamics, *Limnology, *Turbulent flow, *Lake Geneva, Eddy diffusion, Coastal waters, Lakes, Wind, Energy, Spatial distribution, Bays, Shear, Topography, Switzerland, Water currents.

Time series of currents measured during the fall/winter period in a nearshore zone (near a headland and in an adjacent bay) of Lake Geneva, Switzerland were used to determine horizontal turbulent mixing coefficients. Long-term horizontal turbulent mixing coefficients calculated over periods of several months were of 1,000/sq cm/s, a factor of 10 lower than coefficients obtained for coastal zones of larger lakes. Short-term (3 d) mixing coefficients varied between 100/sq cm/s for quiet background situations and 10,000/sq cm/s for periods of wind-induced, large-scale advection. This variability was traced to the history of wind events, indicating that energy input is not sufficiently homogeneous in time to maintain mixing at a constant level. Sheltering by local topography caused the sensitivity of the mixing coefficients to wind direction. Variability in space, with larger values at the headland and smaller ones inside the bay, underlined the modifying influence of shoreline geometry. Inside the bay, diffusion diagrams show that near the surface mixing is generated by shear, while near the bottom inertial subrange diffusion is found. The importance of shear is also evidenced by a correlation between wind forcing and diffusion coefficients for events of long wind fetch. Near the headland, none of these simple concepts holds because local topography influences mixing. (Author's abstract)
W89-11523

ADENINE INCORPORATION INTO DNA AS A MEASURE OF MICROBIAL PRODUCTION IN FRESHWATERS.
Uppsala Univ. (Sweden). Limnologiska Institutionen.
R. T. Bell, and B. Riemann.
Limnology and Oceanography LIOCAH, Vol. 34, No. 2, p 435-444, March 1989. 4 fig, 2 tab, 56 ref. Swedish Natural Science Research Council Grant B-BU 9170-100.

Descriptors: *Physiological ecology, *Microorganisms, *Biosynthesis, *Limnology, *Nucleic acids, *Productivity, Algae, Bacteria, Plankton, Scenedesmus.

The use of (H3)adenine incorporation into DNA as a means of estimating total microbial production in freshwaters was assessed with both algal cultures and natural assemblages of microorganisms. By adding (H3)adenine over a wide range of concentrations (10-200 nM), we determined that in mesotrophic and eutrophic environments > 50 nM and probably > 100 nM of (H3)adenine is required to maximally label the internal precursor pools of both algae and bacteria. With bacterioplankton assemblages, the incorporation of (H3)thymidine and (H3)adenine gave equivalent estimates of DNA synthesis. Growth rates of Scenedesmus in turbidostats determined from C14 assimilation and (H3)adenine incorporation (DNA synthesis) also agreed well. Results suggest that the use of (H3)adenine to measure total microbial (bacteria + algae) production combined with the use of (H3)thymidine to measure 'bacterial' production could provide an interesting complement to current procedures. (Author's abstract)
W89-11524

ORGANIC NITROGEN MINERALIZATION AND SUBSTRATE LIMITATION OF BACTERIA IN LAKE MICHIGAN.
National Oceanic and Atmospheric Administration, Ann Arbor, MI. Great Lakes Environmental Research Lab.
W. S. Gardner, J. F. Chandler, and G. A. Laird.
Limnology and Oceanography LIOCAH, Vol. 34, No. 2, p 478-485, March 1989. 5 fig, 2 tab, 28 ref.

Descriptors: *Limnology, *Nitrogen cycle, *Mineralization, *Lake Michigan, *Bacteria, Seasonal variation, Accumulation, Epilimnion, Amino acids, Incubation, Heterotrophic bacteria, Stratification, Limiting factors.

Labile organic nitrogen mineralization and the apparent degree of bacterial substrate limitation were examined to consider seasonal relationships between substrate availability and bacterial activity in Lake Michigan. Accumulation rates of ammonium nitrogen in amino acid fortified and unfortified samples of epilimnetic Lake Michigan water, incubated in the dark, provided reasonable estimates of potential and actual rates of organic nitrogen mineralization. The labile organic nitrogen demand (LOND), defined as the difference between these respective rates, provided an index of heterotrophic potential. LOND ranged from about 1-3 ng-atoms N/l/h (during May-June and November) to 3-9 ng-atoms N/l/h (during July-October) as compared to actual organic nitrogen mineralization rates of < 1 ng-atom N/l/h in some unfortified samples. The highest LOND, relative to actual turnover, observed in late summer is consistent with the hypothesis that growth rates of epilimnetic Lake Michigan bacteria are strongly limited by organic substrate during late stratification. LOND thus seems to be a useful indicator of heterotrophic

potential in Lake Michigan; this index may also be applicable to other aquatic environments where nitrogen is not a limiting nutrient for microbial populations. (Author's abstract)
W89-11526

COMPARATIVE STUDY ON NUTRIENT CYCLING IN WET HEATHLAND ECOSYSTEMS: II. LITTER DECOMPOSITION AND NUTRIENT MINERALIZATION,
Utrecht Rijksuniversiteit (Netherlands). Dept. of Plant Ecology.
F. Berendse, R. Bobbink, and G. Rouwenhorst.
Oecologia OECOBX, Vol. 78, No. 3, p 338-348, March 1989. 7 fig, 6 tab, 30 ref.

Descriptors: *Cycling nutrients, *Wetlands, *Litter, *Decomposition, *Mineralization, Nutrient requirements, Biomass, Mortality, Nitrogen, Phosphorus, Physiological ecology, Phosphates, Comparison studies, The Netherlands.

The concept of the relative nutrient requirement (L sub n) is used to analyze the effects of the dominant plant population on nutrient cycling and nutrient mineralization in wet heathland ecosystems in The Netherlands. The mass loss and the changes in the amounts of N and P in decomposing above-ground and below-ground litter produced by Erica tetralix and Molinia caerulea were measured over three years. On the basis of the theory that was developed, mineralization rates and ratios between amounts of nutrients in plant biomass and in the soil were calculated on the basis of parameters that were independently measured. There was a reasonable agreement between predicted and measured values in the Erica-communities. In the Molinia-communities, there were large differences between calculated and measured values, which was explained by the observation that the soil organic matter in these ecosystems still predominantly consisted of Erica-remains. (Author's abstract)
W89-11531

DISCRIMINATION BY FRESHWATER ZOOPLANKTON BETWEEN SINGLE ALGAL CELLS DIFFERING IN NUTRITIONAL STATUS.
British Columbia Univ., Vancouver. Dept. of Zoology.
N. M. Butler, C. A. Suttle, and W. E. Neill.
Oecologia OECOBX, Vol. 78, No. 3, p 368-372, March 1989. 3 fig, 42 ref.

Descriptors: *Nutrition, *Limnology, *Zooplankton, *Algae, *Food habits, Copepods, Crustaceans, Daphnia, Chlorophyta, Selenastrum, Filters, Phytoplankton, Plankton, Nitrogen, Limiting nutrients.

Grazing rates of a freshwater copepod (Diaptomus kenai) and a freshwater cladoceran (Daphnia rosea) on the green alga Selenastrum minutum were determined to be dependent on the nutritional status of individual cells. Cells that were less nitrogen-limited were ingested at a greater rate than cells reared under more nitrogen-limited conditions. Diaptomus displayed active discrimination, possibly via chemodetection, while Daphnia expressed passive selection, probably via differential retention on filters. These results suggest that the impact of grazing zooplankton varies with the physiological state of components of the phytoplankton community. Given such variable selectivity, measurements of zooplankton feeding rates using laboratory reared algae could be prone to error stemming from differences in the physiological state of algal cultures. Similar errors would be encountered when characterizing in situ food resources based on microscopic assessment of species or size composition of field phytoplankton samples. Although the mechanisms for selective food uptake are apparently different for copepods and cladocerans, the results for both types of grazers support the idea that the physiological state of algal species may significantly affect major components of the grazing community. (Author's abstract)
W89-11532

SUBMERSED MACROPHYTES AND GRAZING CRAYFISH: AN EXPERIMENTAL STUDY OF HERBIVORY IN A CALIFORNIA FRESHWATER MARSH.
California Univ., Berkeley. Dept. of Entomological Sciences.
J. W. Feminella, and V. H. Resh.
Holarctic Ecology HOECD2, Vol. 12, No. 1, p 1-8, March 1989. 6 fig, 2 tab, 39 ref.

Descriptors: *Marshes, *Submerged plants, *Macrophytes, *Food habits, *Limnology, *Crayfish, *California, Crustaceans, Population density, Ecology, Sago pondweed.

Grazing by the crayfish Procambarus clarkii (Girard) on the abundance of submersed sago pondweed, Potamogeton pectinatus (L.), was quantified during 1984 through 1986 at Coyote Hills Marsh (Alameda County, CA). Annual marsh surveys indicated that P. pectinatus abundance declined (from 70% to 0% of the marsh surface), whereas P. clarkii abundance increased (from 1.6 to almost 3.0 crayfish/trap/week). Crayfish in a 1425 sq m trapping grid were non-aggregated when pondweed was abundant but became aggregated in the remaining pondweed beds as pondweed abundance decreased. In situ exclusion and enclosure experiments using crayfish densities of 0 to 3 individuals/sq m were used to determine if crayfish reduced pondweed. Exclusion of crayfish from areas without pondweed, beginning in midsummer 1984, resulted in plant regrowth; addition of crayfish to these enclosed plots reduced pondweed. Exclusion of crayfish for the entire growing season in 1985 resulted in pondweed persistence in exclusion plots until August; in contrast, pondweed within adjacent, open control plots was eliminated by mid-June. Enclosure experiments showed a strong positive relationship between crayfish density and pondweed clearance. This study demonstrates that grazing crayfish can reduce and, in some cases, eliminate macrophytes from freshwater marshes. (Author's abstract)
W89-11533

EFFECTS OF SOURCE AND DESTINATION ON GROWTH AND METAL UPTAKE IN FRESHWATER CLAMS RECIPROCALLY TRANSPLANTED AMONG SOUTH CENTRAL ONTARIO LAKES,
University of Western Ontario, London. Dept. of Zoology.
For primary bibliographic entry see Field 5C.
W89-11541

LAKE RESTORATION BY REDUCING EXTERNAL PHOSPHORUS LOADING: THE INFLUENCE OF SEDIMENT PHOSPHORUS RELEASE.
North East River Purification Board, Stirling (Scotland).
For primary bibliographic entry see Field 5G.
W89-11543

CHANGES IN NA, K, CA, MG AND AL CONTENT OF SUBMERSED LEAF LITTER, RELATED TO INGESTION BY THE AMPHIPOD GAMMARUS PULEX (L).
Royal Holloway and Bedford New Coll., Egham (England). Dept. of Biology.
A. C. Chamier, D. W. Sutcliffe, and J. P. Lishman.
Freshwater Biology FWBLAB, Vol. 21, No. 2, p 181-189, April 1989. 4 fig, 3 tab, 38 ref.

Descriptors: *Stream biota, *Acid rain effects, *Trace elements, *Leaves, *Decomposing organic matter, *Biodegradation, *Amphipods, *Bioaccumulation, *Sodium, *Potassium, *Calcium, *Magnesium, *Aluminum, Gammarus, Cations, Path of pollutants.

Changes in the amounts of Na, K, Ca, Mg and Al in fallen leaves of oak, alder and mat grass were measured during 13 weeks of submersion in seven streams differing in pH and ionic content. In the first 2 weeks, Na, K and Mg leached from the leaves, but in the following weeks there was a net increase of Al, K and Mg and, in some instances Na and Ca. Increases of K and Mg were relatively larger in circumneutral streams whereas the greatest increases of Al occurred in acid streams. Net gains are attributed to absorption of cations from water by saprophytic microorganisms degrading the leaves, direct adsorption of Al onto leaf tissues (especially in acid streams) and capture of small particles of magnesium and aluminium silicates (clays). Daily ingestion of elements was calculated as a percentage of whole body contents in Gammarus pulex (L.) and compared with daily loss rates. For Na, for instance, a daily ingestion rate of 1-2 percent of whole body contents was calculated, and is negligible compared with a high daily turnover of Na, representing a loss rate of about 65 percent of the entire body Na at 9 C in adult, intermoult animals. At 18 C, losses would be approximately double those recorded in this study. It is thus clear that the animal's requirement for this element must be met almost entirely from Na(+) dissolved in the water, by active absorption across the gills. Leaf litter may be an important source of some major elements for ionic balance in juvenile G. pulex and a major source for uptake of potentially toxic aluminium in acidic, soft waters. (Friedmann-PTT)
W89-11545

PATTERNS OF BENTHIC INVERTEBRATE ASSEMBLAGES IN RIVERS OF NORTHWESTERN NORTH AMERICA.
Windsor Univ. (Ontario). Dept. of Biology.
L. D. Corkum.
Freshwater Biology FWBLAB, Vol. 21, No. 2, p 191-205, April 1989. 6 fig, 7 tab, 39 ref.

Descriptors: *Distribution patterns, *Invertebrates, *North America, *Benthic fauna, *Stream biota, *Ecosystems, *Aquatic populations, Amphipods, Oligochaetes, Mayflies, Caddisflies, Aquatic insects, Population dynamics, Hydrologic properties, Streamflow, Flow velocity, Shallow water, Macroinvertebrates, Ecotypes, Benthic environment, Spatial distribution.

Biogeographical and on-site, hydrological variables were evaluated to determine spatial distribution of benthic invertebrate assemblages at 100 river sites in northwestern North America. Results of cluster analyses suggested that the river sites comprised six groups (A-F), each supporting a characteristic invertebrate assemblage. Distinct groups were best represented by abundant Tricorythidae (C), Amphipods (F), Rhyacophilidae and Systellognatha (E), and Elmidae and Hydroptilidae (A). Brachycentridae (B) and Oligochaeta (D) were widespread throughout the study area. Both biogeographical and hydrological features contributed to the correct classification of site grouping characterized by distinctive fauna. However, biogeographical features were more useful than variables measured at river site in discriminating among the site groupings. Groups C and F were most prevalent within the Hudson Bay drainage. Groups A, C and F were typically located within plains; group E sites were in mountainous regions. The hydrological variables most useful in delineating site groupings were mean current velocity and mean depth. Slow, deep waters characterized amphipod sites; shallow, fast flowing waters occurred at Rhycophilidae/Sysellognatha sites. Results substantiate previous views of a strong association between benthic invertebrates in small rivers and the terrestrial biome through which the river flows. (Author's abstract)
W89-11546

EVALUATION OF THE METABOLISM OF SESTONIC AND EPILITHIC COMMUNITIES IN RUNNING WATERS USING AN IMPROVED CHAMBER TECHNIQUE,
Waterloo Univ. (Ontario). Dept. of Biology.
B. J. Paul, K. E. Corning, and H. C. Duthie.
Freshwater Biology FWBLAB, Vol. 21, No. 2, p 207-215, April 1989. 4 fig, 2 tab, 59 ref.

Descriptors: *Seston, *Benthos, *Lotic environment, *Growth chambers, *Cycling nutrients, *Physiological ecology, *Ecosystems, *Stream biota, Bioaccumulation, Limiting nutrients, Aquatic environment, Metabolism, Quantitative analysis,

Biological properties, Laboratories, Absorption, Oligotrophy, Phosphorus, Tracers.

In situ phosphorus cycling in rivers has been monitored using radiophosphorus or orthophosphate enrichments. With the latter method, addition of orthophosphate must be substantial to allow detectable measurement, yet not exceed the half-saturation constant of the microbial community. Often, this is not possible and may result in gross underestimates of biological cycling. In view of these problems, carbon, nitrogen and phosphorus uptake in enclosed chambers using radioisotopes. This technique allowed quantification of the contributions by abiotic mechanisms and the epilithic and sestonic communities simultaneously in a pristine boreal forest stream in northeast Quebec, Canada. Abiotic adsorption of bicarbonate, glucose, methylammonium and phosphate was unimportant in the riffle investigated. Among the biological components, the epilithon was responsible for more than 87 percent of the uptake of bicarbonate, glucose and methylammonium. The uptake of orthophosphate was predominantly (80 percent) by organisms in the overlying water. Phosphorus, the nutrient most limiting the system, may be conserved by the epilithon through internal cycling. Uptake rates were within the range reported for other oligotrophic systems. (Friedmann-PTT)
W89-11547

HABITAT PATCHINESS AND MACROBENTHIC COMMUNITY STRUCTURE IN AN UPLAND STREAM IN TEMPERATE VICTORIA, AUSTRALIA.
Monash Univ., Clayton (Australia). Dept. of Zoology.
L. A. Barmuta.
Freshwater Biology FWBLAB, Vol. 21, No. 2, p 223-236, April 1989. 4 fig, 7 tab, 53 ref, append.

Descriptors: *Distribution patterns, *Species composition, *Australia, *Stream biota, *Macroinvertebrates, *Benthic fauna, Benthic environment, Ecosystems, Aquatic habitats, Aquatic populations, Physicochemical properties, Seasonal variation, Aquatic animals, Aquatic environment, Hydrological regime.

Patterns of co-occurrence of benthic macroinvertebrates across different habitat patches were monitored for one year at one site on the Acheron River, Victoria. Of the physicochemical aspects of the river, only temperature showed marked seasonality, being lowest in winter (approx. 7 C) and exceeding 16 C during summer. Water was neutral to slighlty acidic with low conductivity, and oxygen concentration was rarely less than 10 percent below saturation. There was a gradual transition in community structure between erosional and depositional habitat extremes. The correspondence between faunally defined sample groups and habitats was not exact. Seasonal changes in community pattern demonstrated were pronounced, but only for erosional habitats. Again, the transition was gradual rather than abrupt and contrasted sharply with data from more severe hydrological regimes. Most of the community pattern was conferred by a minority of the species present. These species generally had special requirements that apparently could be satisfied only by being confined to the surface layer of sediments. Environmental variables alone were insufficient to acccount for all of the patterns of species co-occurrence. It is possible that these variables were measured at scales irrelevant to the requirements of the animals, and that biological interactions (e.g. predation, competition) may have been responsible for the faunal distinctiveness of environmentally similar samples, but the importance of such interactions cannot be inferred from data such as these. (Friedmann-PTT)
W89-11548

CAUSES OF CHANGE IN THE DIVERSITY AND STABILITY OF PHYTOPLANKTON COMMUNITIES IN SMALL LAKES,
Zurich Univ., Kilchberg (Swizerland). Hydrobiological-Limnological Station.
F. Elber, and F. Schanz.
Freshwater Biology FWBLAB, Vol. 21, No. 2, p 237-251, April 1989. 7 fig, 36 ref.

Descriptors: *Population dynamics, *Lakes, *Phytoplankton, *Ecosystems, *Species diversity, Aquatic habitats, Oligotrophic lakes, Eutrophic lakes, Aquatic environment, Cycling nutrients, Switzerland, Zooplankton.

A study of the diversity and stability of phytoplankton communities during one vegetation period (February-October 1984) was carried out in four small lakes in the Pfynwald region of Canton Valais, Switzerland: Kaminsee I, Kaminsee II, Grossee and Rosensee. The diversity was calculated according to Shannon and Weaver, and the change in diversity, delta H' and SIMI (similarity index) were used as measures of stability. On average, the diversity was highest in the oligotrophic Rosensee (annual mean 3.19) and least in the hypereutrophic Kaminsee I (annual mean 1.34). In Kaminsee I and Grossee, the diversity corresponded in the main to the relative frequency of Cryptomonas erosa Ehrenberg: i.e., the diversity was low when the relative frequency of C. erosa was high and vice versa (Kaminsee I: max. diversity 2.74; min. 0.13. Grossee: max. 3.62; min. 0.28; annual mean 2.21). Kaminsee II and Rosensee exhibited only slight variations in their phytoplankton community structure (Kaminsee II: max. diversity 2.83: min. 1.26; annual mean 2.10. Rosensee: max. 3.79; min. 2.81). High values of diversity, or increases in diversity, were a result of low nutrient availability and grazing pressure. Lower diversity values, or decreases in diversity, were a result of plentiful nutrient supply, low grazing pressure and grazer selectivity with respect to food organisms. The change in the diversity, delta H', was influenced mainly by alterations in the nutrient conditions: if these alterations were large, the phytoplankton community was unstable; constant nutrient levels, on the other hand, were associated with stable conditions. Hence, organic pollution may manifest itself by causing a great change in diversity H'. SIMI was found not to be influenced to a great degree by nutrient conditions, but was influenced by zooplankton grazing. Zooplankton grazing can give rise to a small SIMI index (corresponding to a destabilizing effect), especially if the nutrient level remains constant. (Author's abstract)
W89-11549

MICROBIAL GROWTH AND DETRITUS TRANSFORMATIONS DURING DECOMPOSITION OF LEAF LITTER IN A STREAM.
New York Botanical Garden, Bronx, NY. Inst. of Ecosystem Studies.
S. E. G. Findlay, and T. L. Arsuffi.
Freshwater Biology FWBLAB, Vol. 21, No. 2, p 261-269, April 1989. 5 fig, 3 tab, 31 ref.

Descriptors: *Aquatic bacteria, *Aquatic fungi, *Microorganisms, *Biotransformation, *Litter, *Lotic environment, *Detritus, *Decomposing organic matter, Stream biota, Biodegradation, Ecosystems, Population dynamics, Biomass, Fungi, Bacteria, Leaves, Microbial degradation, Particulate matter, Growth, Food chains.

Despite the widely accepted importance of bacteria and fungi in degrading detritus in aquatic ecosystems, there is still very little quantitative information on the abundance and dynamics of these microorganisms. Using epifluorescent microscopy, the biomass of bacteria and fungi during decomposition of three types of leaf detritus were measured. Bacterial production was determined for the rate of incorporation of 3H-thymidine into DNA. The transformation of leaf carbon into dissolved organic carbon and fine particulate organic carbon was followed in order to compare the amounts of leaf material that were converted into these 'end-products' of decomposition versus the amount converted into microbial biomass. The amount of microbial carbon in the leaf-detritus complex never exceeded 5.2 percent of the total carbon, and fungal biomass was always much greater than bacterial biomass. Despite the greater standing stock of fungi, the rapid turnover of bacteria (doubling about once per day) implies that their role in degrading leaf litter or as a food source for detritivores might be as great as for fungi. Removal of microbial biomass from leaf litter may occur as release of fungal spores and consumption or shedding of bacterial biomass. Fungal spores can be a significant part of the fine particulate organic carbon released from leaf detritus and potentially represent an important food resource for filter-feeding organisms. (Author's abstract)
W89-11550

ECOLOGICALLY USEFUL CLASSIFICATION OF MEAN AND NEAR-BED FLOWS IN STREAMS AND RIVERS,
Murdoch Univ. (Western Australia). School of Biological and Environmental Sciences.
For primary bibliographic entry see Field 2E.
W89-11551

CHANGES IN DIATOM-INFERRED PH AND ACID NEUTRALIZING CAPACITY IN A DILUTE, HIGH ELEVATION, SIERRA NEVADA LAKE SINCE A.D. 1825.
California Univ., Santa Barbara. Dept. of Biological Sciences.
For primary bibliographic entry see Field 5B.
W89-11552

FACTORS INFLUENCING PERIPHYTON GROWTH IN AGRICULTURAL STREAMS OF CENTRAL ILLINOIS.
Illinois Natural History Survey, Champaign. Aquatic Biology Station.
M. D. Munn, L. L. Osborne, and M. J. Wiley.
Hydrobiologia HYDRB8, Vol. 174, No. 2, p 89-97, April 15 1989. 3 fig, 3 tab, 29 ref.

Descriptors: *Plant growth, *Epiphytes, *Agricultural watersheds, *Population dynamics, *Limiting factors, *Cycling nutrients, *Aquatic plants, *Stream biota, *Illinois, Ecosystems, Limiting nutrients, Chlorophyll, Substrates, Growth rates, Temperature effects, Light quality.

Factors limiting periphyton accrual in east-central Illinois agricultural streams were investigated. Nutrient-diffusing substrata were used to examine periphyton macronutrient limitation in streams in two agricultural watersheds. Substrata consisted of sand-agar mixtures with one of six experimental treatments. Macronutrients included carbon, nitrate, phosphate and combinations of the three. Substrata were collected after a 5 and 9 day period and analyzed for chlorophyll a. None of the treatments were significantly greater than the controls at any of the seven stations, thus it is concluded that periphyton in these streams was not nutrient limited. Highest periphyton colonization/growth rates were associated with the smaller upstream reaches, while lower rates occurred in the larger downstream reaches. Multiple regression showed that most of the variance in the rate of chlorophyll a accrual after five days was explained through water temperature and turbidity (r squared = 0.91); whereas, stream nitrate and phosphate concentrations accounted for no significant portion of the variance. It is concluded that instream primary production in agricultural streams of central Illinois is limited by temperature and light. (Author's abstract)
W89-11553

BACTERIOPLANKTONIC BIOMASS AND PRODUCTION IN THE RIVER MEUSE (BELGIUM).
Universite Libre de Bruxelles (Belgium). Groupe de Microbiologie des Milieux Aquatiques.
P. Servais.
Hydrobiologia HYDRB8, Vol. 174, No. 2, p 99-110, April 15 1989. 8 fig, 2 tab, 58 ref.

Descriptors: *Aquatic bacteria, *Plankton, *Belgium, *Bacterial analysis, *Biomass, *Stream biota, *Primary productivity, Ecosystems, Aquatic environment, Cycling nutrients, Bacteria, Growth kinetics, Phytoplankton, Absorption, Microscopy, Fluorescence.

Results are presented of bacterial biomass determinations by epifluorescence microscopy after acridine orange staining and 3H-thymidine incorporation measurements in the river Meuse, Belgium. Bacterial production was calculated from thymi-

dine incorporation using an experimental conversion factor (0.5 times 10 to the 18th power bacterial cells produced per mole of thymidine incorporated into macromolecules). Seasonal variations of bacterial biomass and production at two stations are presented. Biomass ranged between 0.05 mg C/l (in winter) and 0.8 mg C/l (in summer). The variations of bacterial production seem to be closely linked to those of primary production; values lower than 1 microgram C/l-h were found in winter and high values (> 5 micrograms C/l-h) in summer. Longitudinal profiles in the Belgian course of the river show important increase of biomass and production from upstream to downstream. Bacterial growth yield (Y) has been determined (Y = 0.3) in order to calculate bacterial carbon uptake from bacterial production. (Author's abstract)
W89-11554

DIEL DRIFT IN CHIRONOMIDAE LARVAE IN A PRISTINE IDAHO MOUNTAIN STREAM.
Geological Survey, Menlo Park, CA.
L. J. Tilley.
Hydrobiologia HYDRB8, Vol. 174, No. 2, p 133-149, April 15 1989. 3 fig, 3 tab, 76 ref.

Descriptors: *Aquatic drift, *Idaho, *Alpine regions, *Stream biota, *Midges, *Larvae, Ecosystems, Spatial distribution, Microinvertebrates, Aquatic animals, Geomorphology.

Simultaneous hourly net collections in a meadow and canyon reach of a mountain stream determined diel and spatial abundances of drifting Chironomidae larvae. The influence of hydrologic and geomorphic conditions on Chironomidae drift are demonstrated. Sixty-one taxa were identified to the lowest practical level, 52 in the meadow and 41 in the canyon. Orthocladiinae was the most abundant subfamily with 32 taxa and a 24 h mean density of 294 individuals/100 cu m (meadow) and 26 taxa and a mean of 648 individuals/100 cu m (canyon). Chironomidae was the second most abundant subfamily. Non-chironomid invertebrates at both sites and total Chrionomidae larvae (meadow) were predominantly night-drifting. Parakiefferiella and Psectrocladium were day-drifting (meadow) whereas 8 other chironomid taxa (meadow) and 2 taxa (canyon) were night-drifting. All others were aperiodic or too rate to test periodicity, Stempellinella cf brevis Edwards exhibited catastrophic drift in the canyon only. The different drift patterns between sites is attributed to greater loss of streambed habitat in the canyon compared to the meadow as streamflow decreased. Consequent crowding of chironomid larvae in the canyon caused catastrophic drift or interfered with drift periodicity. (Author's abstract)
W89-11556

CHARACTERIZATION OF PHYTOPLANKTON EXTRACELLULAR PRODUCTS (PDOC) AND THEIR SUBSEQUENT UPTAKE BY HETEROTROPHIC ORGANISMS IN A MESOTROPHIC FOREST LAKE.
Uppsala Univ. (Sweden). Limnologiska Institutionen.
I. Sundh.
Journal of Plankton Research JPLRD9, Vol. 11, No. 3, p 463-486, May 1989. 4 fig, 10 tab, 56 ref.

Descriptors: *Metabolites, *Organic carbon, *Limnology, *Phytoplankton, *Mesotrophic lakes, *Cycling nutrients, *Heterotrophic bacteria, *Food chains, Ecosystems, Absorption, Metabolism, Organic compounds, Isotopic tracers, Aquatic environment, Biochemistry, Photosynthesis.

The magnitude of phytoplankton release of photosynthetically produced dissolved organic carbon (PDOC), the size distribution and chemical nature of the released substances, and the quantity and composition of PDOC that were immediately assimilated by heterotrophic bacteria were investigated in a meso to oligotrophic, mesohumic forest lake by means of the 14CO2 technique. The percentage extracellular release (PER) was comparatively high (up to about 40 percent). The bulk of the released substances was of high mol. wt (> 5000 dalton), with a minor contribution from low mol. wt (< 1000 dalton) compounds. Heterotrophic bacteria preferentially assimilated the high molecular weight components of PDOC, and a polysaccharide of about 6000 dalton with a very short turnover time was a key substance in the carbon flow from autotrophic phytoplankton to heterotrophic bacteria. A few of the shortcomings of the 14CO2 method to assess phytoplankton release of PDOC are identified. For instance, when a natural plankton sample is filtered using vacuum, there is a risk that the cells will break when they are retained by the filter. In this process, particulate 14 C-labelled substances will leak into the filtrate and the extracellular release will be overestimated. (Author's abstract)
W89-11559

DOES THE CHLOROPHYLL A CONTENT OF PHYTOPLANKTON VARY WITH TROPHIC STATUS IN LAKES ON THE NEW ZEALAND CENTRAL VOLCANIC PLATEAU.
Department of Scientific and Industrial Research, Hamilton (New Zealand). Water Quality Centre.
R. D. Pridmore, J. E. Hewitt, and A. B. Cooper.
Journal of Plankton Research JPLRD9, Vol. 11, No. 3, p 583-593, May 1989. 6 tab, 61 ref.

Descriptors: *Limnology, *Phytoplankton, *Chlorophyll, *Trophic level, *New Zealand, *Mountain lakes, *Cycling nutrients, Ecosystems, Eutrophic lakes, Lakes, Aquatic environment, Nitrogen, Phosphorus, Particulate matter.

Recently, it had been shown that ratios of chlorophyll a to particulate phosphorus (Chl a/PP) and chlorophyll a to particulate nitrogen (Chl a/PN) were significantly higher in eutrophic than oligo/mesotrophic waters in 17 lakes on the central volcanic plateau, North Island, New Zealand. This difference was thought to be due to an increase in the chlorophyll a content of phytoplankton in these eutrophic lakes. Corresponding measurements of chlorophyll a and phytoplankton cell volume made during this study do not support this hypothesis. However, ratios of chlorophyll a to adenosine triphosphate and estimates of percentage phytoplankton biomass were significantly higher ($P < 0.05$) in eutrophic than in oligo/mesotrophic samples, suggesting that Chl a/PP and Chl a/PN may be high in eutrophic waters simply because phytoplankton comprise more of the total microbial biomass. This hypothesis is supported by a strong linear relationship ($r = 0.88$, $P < 0.001$) between Chl a/PP and percentage phytoplankton biomass in six of the study lakes where corresponding measurements were made. (Author's abstract)
W89-11562

TEMPERATURE-INDEPENDENT GROWTH OF PHYTOPLANKTON,
Department of Agriculture for Northern Ireland, Antrim. Freshwater Biological Investigation Unit.
C. E. Gibson, and R. H. Foy.
Journal of Plankton Research JPLRD9, Vol. 11, No. 3, p 605-607, May 1989. 1 tab, 10 ref.

Descriptors: *Limnology, *Growth rates, *Population dynamics, *Phytoplankton, Diatoms, Biomass, Respiration, Ecosystems, Aquatic plants, Aquatic environment, Photosynthesis, Biochemistry, Culturing techniques, Chlorophyta, Temperature effects, Light intensity, Limiting factors.

The temperature independence of growth rate in some planktonic diatoms and chlorophytes is demonstrated and is related to a temperature-insensitive respiration rate. This was achieved using cells grown in batch culture in dilute suspension with a thin layer of culture medium. Growth rates of two freshwater diatoms and three chlorophytes were compared under 3 h days at 10 micromoles/sq m/s. Specific growth rates ranged between 0.03/day and 0.055/day for the different species and were in every species independent of temperature in the range of 8 C to 16 C. Setting photosynthesis (P) at 0.1/h and respiration (R) at a constant 0.01/h, a daily balance of P-R=0.3-0.24=0.06/day was derived. If respiration has a temperature quotient (Q sub 10) of 2.0 an 8 C rise in temperature would result in a negative P-R of minus 0.11/day. Results of these experiments imply either that the P:R ratio is much lower than previously measured under similar conditions, or, more plausibly, that respiration is linked to growth and that under strict light limitation, neither responds to temperature. (Friedmann-PTT)
W89-11564

ESTIMATING TERMINAL LAKE LEVEL FREQUENCIES.
Houston Engineering, Inc., Fargo, ND.
L. H. Woodbury, and G. Padmanabhan.
Journal of Water Resources Planning and Management (ASCE) JWRMD5, Vol. 115, No. 3, p 321-337, May 1989. 9 fig, 4 tab, 26 ref, append.

Descriptors: *Closed lakes, *Lakes, *Water level fluctuations, *Optimum development plans, Frequency analysis, Regression analysis, Mathematical models, Cyclic storage, North Dakota, Estimating.

A reliable method of predicting long-term future lake levels with associate exceedance frequencies is essential to establish planning elevations in the lake shore environment. A methodology is proposed here to develop level-frequency relationships for terminal lakes. The methodology is applied to Devil's Lake, North Dakota. An autoregressive moving average (ARMA) model with a deterministic trend component for the annual storage changes is used as the basis. The storage changes are derived from the historical annual average level time series, and the level-storage relationship. Using the validated ARMA model and simulation techniques, many sequences of annual incremental storage time series are generated. The concepts of mass curve and range analysis are applied to each synthetic sequence for deriving maximum and minimum lake volumes in each sequence. The resulting set of maximum and minimum lake volumes are then analyzed for their underlying frequency distributions. Utilizing the elevation-storage function, the lake volume-frequency relationship is converted to an annual average lake level-frequency relationship. A separate treatment of within-year maximum fluctuations about the average level is also developed. Both the average level and within-year maximum fluctuation distributions represent the stochastic behavior of the lake and thus are found to be necessary to the development of the level-frequency relationship. (Author's abstract)
W89-11599

OCCURRENCE OF BACTERIVORY IN CRYPTOMONAS, A COMMON FRESHWATER PHYTOPLANKTER.
Lund Univ. (Sweden). Inst. of Limnology.
L. J. Tranvik, K. G. Porter, and J. M. Sieburth.
Oecologia OECOBX, Vol, 78, No. 4, p 473-476, March 1989.

Descriptors: *Food chains, *Limnology, *Phytoplankton, *Aquatic bacteria, *Cryptomonas, Lakes, Nutrients, Carbon, Ingestion, Feeding rates, Nutrients, Bacterivory.

Bacterivory was detected by incorporation of 0.57 micrometer diameter, fluorescent polystyrene beads and fluorescently labeled bacteria (FLB) in two cultured species of Cryptomonas (C. ovata and C. erosa), and a population of Cryptomonas sp in a humic, mesotrophic lake. Rates of ingestion and clearance were very low, and similar for the cultures and the in situ population. The in situ population incorporated 0.7-1.7 bacteria/cell/h, thereby ingesting 0.3-2.0% of the total bacterial numbers present in the water per day, and receiving less than 2% of its carbon content per day through bacterivory. Thus, bacterivory by Cryptomonas was quantitatively important neither as a sink for bacterial biomass, nor as a carbon source for the algal cells. Possibly, it served in the uptake of essential nutrients. (Author's abstract)
W89-11605

RESULTS ON EXPLORATORY FISHING SURVEY IN SALTO GRANDE RESERVOIR (RESULTADOS DE LA PROSPECCION PESQUERA EN EL EMBALSE DE SALTO GRANDE).

Instituto Nacional de Investigacion y Desarrollo Pesquero, Mar del Plata (Argentina).
For primary bibliographic entry see Field 8I.
W89-11609

PEAT CHEMISTRY OF A CONTINENTAL MIRE COMPLEX IN WESTERN CANADA.
Alberta Univ., Edmonton. Dept. of Botany.
B. Nicholson.
Canadian Journal of Botany CHBOAW, Vol. 67, No. 3, p 763-775, March 1989. 8 fig, 2 tab, 53 ref. Natural Sciences and Engineering Research Council, Grant A6390.

Descriptors: *Wetlands, *Peat, *Peat bogs, *Fens, *Canada, Sphagnum, Chemical properties, Hydrogen ion concentration, Calcium, Magnesium, Conductivity, Statistical analyses, Forests, Minerals, Vegetation.

A continental peatland complex in western Canada containing varied vegetational landforms was studied to relate surface physiography to peatland development. Peat chemistry was used to determine the influence of water chemistry on landform formation and to assess the development of ombrotrophy on forested Sphagnum islands. Surface water chemistry at the site showed the following: pH 3.7-6.3; calcium content 0.9-15.6 mg/L; magnesium content 0.5-2.8 mg/L; and reduced conductivity 0-232 microS/cm. Peat cores were subdivided into two peat types, fen and forested Sphagnum islands. Spearman rank correlations and the Mann-Whitney U-test were used to determine significant differences in ash, bulk density, calcium, and magnesium. Elemental contents of surface peats are directly related to landform features. Elemental peat profiles exhibit three accumulation trends: stable, increasing, and declining. Fen peats have profiles that are stable or increase towards the peat surface, whereas forested Sphagnum island peats have profiles that decline toward the peat surface. During the development of the mire, fen peats receiving mineral-enriched waters have accumulated higher amounts of mineral ions. Forested Sphagnum islands have developed in hydrologically sheltered areas, resulting in the formation of mineral-poor peat. Surface water, vegetation, and peat stratigraphy suggest that the forested Sphagnum islands have become ombrotrophic, forming local recharge zones with a gradual transition from a mineral-poor environment to ombrotrophy. (Author's abstract)
W89-11615

BIOLOGICAL IMPOVERISHMENT IN LAKES OF THE MIDWESTERN AND NORTHEASTERN UNITED STATES FROM ACID RAIN.
Department of Fisheries and Oceans, Winnipeg (Manitoba). Freshwater Inst.
For primary bibliographic entry see Field 5C.
W89-11621

DISTRIBUTION AND STATUS OF RARE OR ENVIRONMENTALLY SENSITIVE FISHES IN THE LOWER CAHABA RIVER, ALABAMA.
Alabama Power Co., Birmingham.
J. M. Pierson, R. S. Krotzer, and S. G. Puleo.
Journal of the Alabama Academy of Science JAASAJ, Vol. 60, No. 1, p 1-10, January 1989. 1 fig, 22 ref.

Descriptors: *Stream biota, *Fish populations, *Alabama River, *Rare and endangered species, Shiner, Darters, Cahaba River, Environmental effects, Distribution patterns, Biological samples.

Eighty-four collections were made in the lower Cahaba River drainage, a major tributary of the Alabama River in central Alabama, with seine, gill nets, and electrofishing equipment from May 1981 to June 1986. Over 32,000 specimens were collected representing 20 families and 104 species. Distribution records are presented for 13 rare or environmentally sensitive fishes that occupy the main channel Cahaba River or a few of its larger tributaries; five of the species have been assigned some form of conservation status. Range extensions were discovered for Notropis sp. cf. volucellus (undescribed Cahaba shiner), Percina aurolineata (goldline darter), and Percina sp. cf. copelandi (undescribed channel darter). Notropis candidus (silverside shiner) is reported from the Cahaba River for the first time. Many Alabama rivers have undergone various degrees of environmental stress resulting in the reduction or elimination of populations of many species in these systems. While the upper Cahaba River has apparently been impacted by some of these same stresses, it appears that the lower section of the Cahaba River could be serving as a refugium for several vulnerable riverine species. (Author's abstract)
W89-11625

DETERMINATION OF LEAD IN WATERS AND SEDIMENTS OF LAKE DONNER, CALIFORNIA.
California State Polytechnic Univ., Pomona. Dept. of Chemistry.
For primary bibliographic entry see Field 5A.
W89-11643

ACIDITY STATUS AND PHYTOPLANKTON SPECIES RICHNESS, STANDING CROP, AND COMMUNITY COMPOSITION IN ADIRONDACK, NEW YORK, U.S.A. LAKES.
New York State Museum, Albany. Science Service Div.
For primary bibliographic entry see Field 5C.
W89-11653

PLANKTONIC ROTIFER COMMUNITY STRUCTURE IN ADIRONDACK, NEW YORK, U.S.A. LAKES IN RELATION TO ACIDITY, TROPHIC STATUS AND RELATED WATER QUALITY CHARACTERISTICS.
New York State Museum, Albany. Science Service Div.
For primary bibliographic entry see Field 5C.
W89-11654

INTEGRATED APPROACH TO HYDROPOWER IMPACT ASSESSMENT: II. SUBMERGED MACROPHYTES IN SOME NORWEGIAN HYDROELECTRIC LAKES,
Norsk Inst. for Vannforskning, Oslo.
For primary bibliographic entry see Field 6G.
W89-11655

ESTABLISHING AND MAINTAINING LABORATORY-BASED MICROCOSMS OF RIFFLE INSECT COMMUNITIES: THEIR POTENTIAL FOR MULTISPECIES TOXICITY TESTS.
Virginia Polytechnic Inst. and State Univ., Blacksburg. Center for Environmental and Hazardous Material Studies.
For primary bibliographic entry see Field 5A.
W89-11656

ROUGHNESS AND COLOR OF ARTIFICIAL SUBSTRATUM PARTICLES AS POSSIBLE FACTORS IN COLONIZATION OF STREAM INVERTEBRATES.
Alberta Univ., Edmonton. Dept. of Zoology.
H. F. Clifford, V. Gotceitas, and R. J. Casey.
Hydrobiologia HYDRB8, Vol. 175, No. 2, p 89-95, May 8 1989. 1 fig, 2 tab, 18 ref.

Descriptors: *Colonization, *Macroinvertebrates, *Substrates, *Population density, *Stream biota, *Animal behavior, Mayflies, Aquatic environment, Midges, Aquatic populations.

The null hypothesis, stating that neither roughness nor color of artificial substrata (tiles) affects abundance of stream invertebrates colonizing these substrata, was tested. The studies were carried out in a third-order aspen-parkland stream and first-order and second-order foothills streams of Alberta, Canada. Dark-colored tiles were slightly more attractive to some colonizing invertebrates and more taxa were found on the rough tiles than on the smooth tiles. Also, several taxa were found in significantly ($P < or = 0.05$) larger numbers on the rough tiles. Chironomids, especially, had a strong preference for the rough tiles. A major exception was heptageniid (Ephemeroptera) nymphs, which were consistently found in larger numbers on the smooth tiles. (Author's abstract)
W89-11658

DIURNAL CHANGES IN ZOOPLANKTON RESPIRATION RATES AND THE PHYTOPLANKTON ACTIVITY IN TWO CHILEAN LAKES.
Ulster Univ., Coleraine (Northern Ireland). Dept. of Biology.
T. E. Andrew, S. Cabrera, and V. Montecino.
Hydrobiologia HYDRB8, Vol. 175, No. 2, p 121-135, May 8 1989. 10 fig, 4 tab, 34 ref.

Descriptors: *Limnology, *Zooplankton, *Chile, *Oxygen requirements, *Lakes, *Reservoirs, *Respiration, Diurnal distribution, Migration, Aquatic populations, Cycling nutrients, Photosynthesis, Oxygen, Waterfleas, Copepods, Animal behavior.

Respiration rates of natural zooplankton communities were measured for diel cycles in two lakes. Distinct diurnal cycles were observed in Embalse Rapel with high respiratory rates for the spring cladoceran dominated zooplankton at dawn and dusk. Very restricted diurnal variation was seen in the copepod-dominated zooplankton of Lago Chungara. During the study period at Rapel, the phytoplankton photosynthesis remained fairly constant at values an order of magnitude higher than in Chungara. The amplitude of difference between the minimum respiratory rates, dark period and daytime, and the higher dawn and dusk rates found in Rapel, is high, and the results are comparable with those of earlier studies. When respiratory measurements, which are usually made during daytime at minimum levels, are used to estimate total energy expenditure, these will underestimate daily oxygen consumption by 40 percent. If the lower levels of respiration rate represent a minimum activity level of the zooplankton, the difference indicates the proportion of energy allocated to migration and feeding. The explanation for the difference in pattern and extent of respiratory cycle found in Chungara may be due to the restricted depth distribution of zooplankton, the bulk of which were between 4 and 10 m, severely limiting migration in a diel cycle. In impoverished food environments, it would appear to be energetically sensible for zooplankton to minimize energy expenditure on migratory movements. (Friedmann-PTT)
W89-11660

DYNAMICS OF FECAL COLIFORM AND CULTURABLE HETEROTROPH DENSITIES IN AN EUTROPHIC ECOSYSTEM: STABILITY OF MODELS AND EVOLUTION OF THESE BACTERIAL GROUPS.
Montpellier-2 Univ. (France). Lab. d'Hydrobiologie Marine.
M. Troussellier, and P. Legendre.
Microbial Ecology MCBEBU, Vol. 17, No. 3, p 227-235, 1989. 3 fig, 16 ref.

Descriptors: *Heterotrophic bacteria, *Population dynamics, *Wastewater lagoons, *Wastewater treatment, *Coliforms, *Eutrophication, *Population density, *Wastewater lagoons, Model studies, Temporal distribution, Aquatic environment, Bacteria, Microorganisms, Succession, Ecosystems, Seasonal variation.

Time series of a population of fecal coliforms and a community of total viable counts were recorded during years 5 and 6 after the 'birth' of an eutrophic aquatic ecosystem (sewage treatment lagoons). These time series were used to re-examine models, previously published, describing their temporal dynamics as well as the relationships between bacterial and environmental variables. The dynamics of the fecal coliforms and their relationships to the environment were unchanged; the fecal coliform abundances displayed an annual cycle with maximum reduction in numbers during the summer, which would be due at least partly to environmental variables (hypotheses of control by irradiance and pH, which have a seasonal behavior, are supported by the data). On the contrary, the total viable count dynamics move toward a

closer dependence on phytoplankton, from a situation of relative independence with respect to other biotic components of the ecosystem. During the first two years, only one of the abiotic variables in the model (the biological oxygen demand, which is an indicator of available organic matter) seemed to have an effect on the total viable counts. The behavior of these bacterial groups, measured during 1980-1982 and 1984-1986, shows that demographic and ecological laws founded on the observation of other organisms also apply to heterotrophic bacteria. A population, such as the fecal coliforms in the present study, has a limited ecological amplitude and is then more likely to react to environmental variables such as irradiance, pH, and phytoplanktonic metabolic products, whose bactericidal action is highest during the summer months and lowest during winter. On the other hand, a community such as that detected by the total viable counts of the present study, is composed of many species and thus has a larger ecological amplitude. This makes it easier for the species to occupy the various available habitats and to maintain themselves through ecological succession and endogenous rhythms. (Author's abstract)
W89-11663

COMPARISON OF THREE TECHNIQUES FOR ADMINISTERING RADIOLABELED SUBSTRATES TO SEDIMENTS FOR TROPHIC STUDIES: INCORPORATION BY MICROBES.
Florida State Univ., Tallahassee. Dept. of Oceanography.
For primary bibliographic entry see Field 7B.
W89-11664

SCALE CHRYSOPHYTES (CHRYSOPHYCEAE AND SYNUROPHYCEAE) FROM NATIONAL PARK LAKES IN SOUTHERN AND CENTRAL FINLAND.
Jyvaeskylae Univ. (Finland). Dept. of Biology.
P. Eloranta.
Nordic Journal of Botany NJBODK, Vol. 8, No. 6, p 671-681, 1989. 9 fig, 4 tab, 11 ref.

Descriptors: *Limnology, *Finland, *Oligotrophic lakes, *Aquatic plants, *Chrysophyta, *Algae, *Species diversity, *Lakes, Ecosystems, Peat bogs, Hydrogen ion concentration, Trophic level, Electron microscopy, Species composition.

A total of 34 scaled chrysophyte taxa (18 Mallomonas spp., 6 Synura spp., 2 Chrysosphaerella spp., 6 Spiniferomonas spp. and 2 Paraphysomonas spp.) were recorded by scanning electron microscopy techniques in 61 samples from 59 lakes located in 8 national parks of southern and central Finland in July 1987. Most of the lakes were small forest and peat bog lakes with acid (pH 4.6-7.2) and soft-water and with variable water color (10-350 mg Pt/l). The number of taxa per lake varied from 0 to 15 and it correlated very significantly with the water pH. The species structure was rather typical for the oligotrophic and acid lakes. Species like Mallomonas caudata (fr. 72.1 percent of lakes), M. crassisquama (65.6 percent), M. allorgei (62.3 percent) and M. akrokomos (52.5 percent) were eurytypic and common. M. canina (41.0 percent) and M. hamata (21.3 percent) were also frequently observed. M. calceolus, M. costata, M. papillosa, M. pugio and M. paludosa were more rare but typical for acid lakes. Synura splendida that occurred in two lakes was the rarest and a new species for Finland. (Author's abstract)
W89-11667

WETLAND VEGETATION NEAR OLD CROW, NORTHERN YUKON.
Geological Survey of Canada, Ottawa (Ontario).
L. Ovenden, and G. R. Brassard.
Canadian Journal of Botany CJBOAW, Vol. 67, No. 4, p 954-960, April 1989. 2 fig, 1 tab, 40 ref.

Descriptors: *Species composition, *Limnology, *Wetlands, *Peat bogs, *Aquatic plants, *Vegetation, *Yukon Territory, *Soil-water-plant relationships, Species diversity, Aquatic environment, Marshes, Mosses, Soil chemistry, Hydrogen ion concentration, Ecological distribution.

Wetland vegetation on lowlands of northern Yukon was related to gradients of pH, peat depth, and active-layer depth using detrended correspondence analysis. Seven vegetation types were distinguished by two-way indicator species analysis: Arctophila shoreline marsh, Carex aquatilis-Sphagnum-Chamaedaphne wet meadow, Scorpidium-sedge carpet, Carex rotundata-Andromeda-Sphagnum orientale lawn, Sphagnum-heath on firm peat, thickets and tussock tundra, and Calamagrostis canadensis meadow. The Arctophila marshes and tussocky shrublands resemble other sites in the subarctic and low arctic wetland regions of North America, while Sphagnum-heath on firm peat is typical of high boreal and subarctic wetlands. The wet meadow, carpet, and lawn types of sedge-moss vegetation cannot be characterized as arctic or boreal because the geographic patterns of sedge-moss wetlands in northwest North America remain unclear. (Author's abstract)
W89-11669

PROPOSALS FOR INHIBITING ABUNDANT PHYTOPLANKTON GROWTH AT THE HEAD OF A RIVER RESERVOIR.
Ehime Univ., Matsuyama (Japan). Dept. of Environment Conservation.
For primary bibliographic entry see Field 5G.
W89-11702

MEASURING DISCONTINUITIES IN THE TER RIVER.
Barcelona Univ. (Spain). Dept. de Ecologia.
F. Sabater, J. Armengol, and S. Sabater.
Regulated Rivers Research and Management RRRMEP, Vol. 3, No. 1-4, p 133-142, Jan-Apr 1989. 4 fig, 21 ref.

Descriptors: *Environmental gradient, *Stream profiles, *Regulated flow, *River systems, *Spain, Discontinuities, Mathematical equations, Physical properties, Morphological properties, Chemical properties, Diatoms, Salinity, Stream pollution, Reservoirs.

A method is proposed for measuring discontinuities caused by human disturbance of the spatial organization of a river. The method compares environmental gradients defined by variables represented as parametric distances between sites. When these parametric distances are plotted in relation to the geographical ones, the distortion between compared river images appears as an expression of the changes occurring in each stretch. To define a river gradient the general trend of a variable needs to be calculated, using direct gradient analysis. The fit of the results obtained from an undisturbed stretch to an empirical curve for all the river gives a measure of the expected values for that river. The difference between expected and observed values can be a measure of the discontinuity. This method has been applied to the previous studies of the Ter river, Spain. Physiographic and morphologic parameters were chosen to understand the river structure, and physical and chemical features were used to determine the physical and chemical variables. Diatom communities were studied to understand the river life structure. The Principal Components analysis results for each one of these three groups of variables reveal that the first factor in all three analyses is related to the spatial organization of the river. The site ordination originated by the first factor defines a new ecological comparison of each of the discontinuities produced along the river. Water salinity, pollution, and reservoirs existence appear as the main factors which determine diatom assemblage distribution along the River Ter. Representation of the calculated ecological distances with respect to the geographical ones is shown to be a useful tool for comparing parameter derivatives. (White-Reimer-PTT)
W89-11703

BIOTIC AND ABIOTIC GRADIENTS IN A REGULATED HIGH ELEVATION ROCKY MOUNTAIN RIVER.
Colorado State Univ., Fort Collins. Dept. of Biology.
For primary bibliographic entry see Field 6G.
W89-11704

EFFECTS OF AN UPLAND IMPOUNDMENT ON STRUCTURAL AND FUNCTIONAL PROPERTIES OF A SMALL STREAM IN A BASALTIC PLATEAU (GOLAN HEIGHTS, ISRAEL).
Tel-Aviv Univ. (Israel). Inst. for Nature Preservation Research.
For primary bibliographic entry see Field 6G.
W89-11705

SERIAL DISCONTINUITIES IN A ROCKY MOUNTAIN RIVER. I. DISTRIBUTION AND ABUNDANCE OF PLECOPTERA.
Montana Univ., Polson. Flathead Lake Biological Station.
For primary bibliographic entry see Field 6G.
W89-11706

SERIAL DISCONTINUITIES IN A ROCKY MOUNTAIN RIVER. II. DISTRIBUTION AND ABUNDANCE OF TRICHOPTERA.
Montana Univ., Polson. Flathead Lake Biological Station.
For primary bibliographic entry see Field 6G.
W89-11707

CHANGES IN BENTHIC ANIMAL PRODUCTION OF A WEIR BASIN AFTER EIGHT YEARS OF SUCCESSION.
Bergen Univ. (Norway). Zoological Museum.
For primary bibliographic entry see Field 6G.
W89-11708

REVIEW OF THE EFFECT OF RIVER REGULATION ON MAYFLIES (EPHEMEROPTERA).
Oslo Univ. (Norway). Lab. for Freshwater Ecology and Inland Fisheries.
For primary bibliographic entry see Field 6G.
W89-11709

STUDY OF PHYSICAL PARAMETERS AT THE SPAWNING SITES OF THE EUROPEAN GRAYLING (THYMALLUS THYMALLUS L.).
Fiskeristyrelsen, Haernoesand (Sweden). Regional Office.
A. P. Gonczi.
Regulated Rivers Research and Management RRRMEP, Vol. 3, No. 1-4, p 221-224, Jan-Apr 1989. 1 fig, 1 tab, 11 ref.

Descriptors: *Fish behavior, *Spawning, *Dam effects, *Fish populations, Sweden, River beds, European grayling, Substrate, Temperature, Flow, Life cycles, Regulated flow.

An investigation of the spawning sites of European grayling, Thymallus thymallus (L.), in two Swedish rivers revealed a narrow range in their physical parameters. The bottom substrate was composed of 10-20 per cent sand, 50-70 per cent gravel (< 2 cm), 20-30 per cent stones (2-10 cm), and a few bigger stones (> 10 cm in diameter). Eggs were found only where the gravel thickness was more than 5 cm. The depth varied between 30-50 cm. Mean depth for 22 different spawning sites was 36 cm. The water velocity varied between 23-90 cm/s, average 54 cm/s. The temperature at the start of spawning was 3.9 C and at the end it was about 9 C. The results indicate the narrow range in physical parameters at the spawning sites. Small changes in the environment caused by regulation of river flow or water level may disturb the spawning behavior of grayling and cause a decrease in population size or even extinction. (Author's abstract)
W89-11711

REMOVAL OF BROWN TROUT (SALMO TRUTTA L.): CHANGES IN POPULATION DYNAMICS IN A WEIR BASIN IN WESTERN NORWAY.
Bergen Univ. (Norway). Zoological Museum.
For primary bibliographic entry see Field 8I.
W89-11712

EFFECTS OF STREAM REGULATION ON ATLANTIC SALMON, SALMO SALAR L., AND

BROWN TROUT, SALMO TRUTTA L., IN THE UPPER SEVERN CATCHMENT, U.K.
Humberside Coll. of Higher Education, Grimsby (England).
For primary bibliographic entry see Field 6G.
W89-11713

EXPLOITATION RATE, SURVIVAL AND MOVEMENTS OF BROWN TROUT (SALMO TRUTTA L.) STOCKED AT TAKEABLE SIZE IN THE REGULATED RIVERS LAGEN AND OTTA, SOUTHERN NORWAY.
Environmental Division, Statsetatenes hus, N-2600 Lillehammer, Norway.
J. Skurdal, O. Hegge, and T. Hesthagen.
Regulated Rivers Research and Management RRRMEP, Vol. 3, No. 1-4, p 247-253, Jan-Apr 1989. 3 fig, 3 tab, 15 ref.

Descriptors: *Sport fishing, *Fish behavior, *Fish harvest, *Stream fisheries, *Trout, *Fish stocking, *Regulated flow, *Norway, Fish recapture, Fish size, Survival.

Takeable size (age 4+, length 27-67 cm), hatchery reared brown trout (Salmo trutta L.) were released into the rivers Lagen and Otta, the Glomma River System, southern Norway, in May-July 1981 and 1983-87. The brown trout released in May gave significantly lower recapture rates compared to those released in June/July, i.e. 22.8 per cent compared to 41.6-58.0 per cent, respectively. Mean exploitation rate and survival rates ranged from 0.23 to 0.58 and 0.02 to 0.14, respectively. Within 15 days after release 50 per cent were recaptured, and 90 per cent were caught within 67 days. The frequency of recapture increased significantly with fish length in the length interval 30-45 cm, but decreased for bigger fish. The stocked brown trout were stationary and 95 per cent of the recaptures were caught less than 1 km from the site of release. Frequency of recapture ranged from 19.2 to 54.7 per cent in 6 experiments with takeable sized brown trout in different tributaries of the Glomma River System, and the variations are probably due to differences in fishing pressure. (Author's abstract)
W89-11714

ABILITY OF PHABSIM TO PREDICT CHINOOK SALMON SPAWNING HABITAT.
Department of Fisheries and Oceans, Nanaimo (British Columbia). Pacific Biological Station.
For primary bibliographic entry see Field 8I.
W89-11717

DEVELOPMENT OF HABITAT SUITABILITY CRITERIA FOR TROUT IN SMALL STREAMS.
Pacific Gas and Electric Co., San Ramon, CA.
T. R. Lambert, and D. F. Hanson.
Regulated Rivers Research and Management RRRMEP, Vol. 3, No. 1-4, p 291-303, Jan-Apr 1989. 7 fig, 16 ref.

Descriptors: *Aquatic habitats, *Stream biota, *Trout, *Fish populations, California, Model studies, Habitats, Instream flow incremental methodology, Water depth, Flow, Fish behavior, Sampling.

In order to determine habitat utilization in small streams of the Kings River basin in California's Sierra Nevada mountains 2863 trout were observed in the wild. The habitat utilization data were used to develop habitat suitability functions that provide input variables to the instream flow incremental methodology (IFIM) habitat assessment model of the U.S. Fish and Wildlife Service. Observations of the habitat utilization of rainbow trout (Salmo gairdneri), brown trout (Salmo trutta), and brook trout (Salvelinus fontinalis) were obtained during the summer months of 1983 and 1984. The observations were made in small streams with discharges ranging from 0.7 cu m/s to 0.03 cu m/s. Individual trout of all species and life stages were most often observed in the lower half of the water column, utilizing low-velocity currents of less than 3.0 cm/s. From the depth and velocity utilization data, several forms of habitat suitability functions were developed and evaluated: (1) univariate depth and velocity functions derived from frequency histogram analysis; (2) univariate depth and univariate velocity exponential polynomial models; and (3) bivariate depth and velocity exponential polynomial models. Univariate exponential polynomial models provided the best fit to the data for each species, based on visual comparisons of response surfaces and contour plots, and comparisons of computed sums of squared errors. Bivariate models fitted to the data resulted in greater sums of squared errors than multiplicative aggragation of univariate models, and frequently predicted utilization at zero depth. The habitat suitability functions derived from the univariate exponential polynomial models provided the best input to the IFIM habitat assessment models. (Author's abstract)
W89-11718

ANALYSIS OF BROWN TROUT (SALMO TRUTTA FARIO L.) HABITAT: THE ROLE OF QUALITATIVE DATA FROM EXPERT ADVICE IN FORMULATING PROBABILITY-OF-USE CURVES,
Aix-Marseille-1 Univ. (France). Lab. d'Hydrobiologie.
P. Chaveroche, and C. Saboton.
Regulated Rivers Research and Management RRRMEP, Vol. 3, No. 1-4, p 305-319, Jan-Apr 1989. 7 fig, 1 tab, 3 ref.

Descriptors: *Aquatic habitats, *Trout, *Fish management, *Fish populations, Data acquisition, Questionnaires, Expert opinions, Data interpretation, Growth stages, Instream flow.

In order to study the preferred habitat of brown trout, a group of fifteen experts met in Tarn Department to answer a questionnaire relating to 200 sampled points on the Agout river. The experts were requested to give their opinion on the suitability of various habitats, defined by velocity, depth, substrate, presence of covers, etc. for trout--at each stage of growth, fry, juvenile and adult fish--and the factors which had influenced their choice. The analysis of these questionnaires allowed probability-of-use curves to be plotted for brown trout. The agreement between the curves derived from this study and those proposed by Bovee is encouraging and gives credit to the validity of the Instream Flow Incremental Methodology. Direct analysis of the data collected led to conclusions in agreement with the probability-of-use formulation and has identified the best conditions of habitat at different stages of growth of trout. Depth, velocity, substratum parameters (vicinity of banks, presence of vegetation, shelters, hunting grounds) were all regarded as important. In addition, discussions with the participants clarified a certain number of criticisms and identified points to be examined more thoroughly. The use of presence or absence data prevented the calibration of answers and could perhaps introduce bias in the findings to the extent that all the experts do not necessarily have the same understanding of the concept underlying their positive or negative answers. The analysis of habitats thus performed is limited in space (1 sq m) and is based on the independence of morphodynamic parameters in the design of curves. Some experts have limited their analysis to the sq m examined, but most have finally made more general appraisals by integrating parameters describing the neighboring environment. (White-Reimer-PTT)
W89-11719

PROBABILITY-OF-USE CURVES APPLIED TO BROWN TROUT (SALMO TRUTTA FARIO L.) IN RIVERS OF SOUTHERN FRANCE.
Ecole Nationale Superieure Agronomique de Toulouse (France).
A. Belaud, P. Chaveroche, P. Lim, and C. Sabaton.
Regulated Rivers Research and Management RRRMEP, Vol. 3, No. 1-4, p 321-336, Jan-Apr 1989. 8 fig, 1 tab, 15 ref.

Descriptors: *Fish behavior, *Stream biota, *Trout, Fish populations, *France, Instream Flow Incremental Methodology, Habitats, Water depth, Velocity.

At various randomly distributed points on five tributaries of the Tarn and Ariege rivers the occurrence of fishes at different stages of development and selected morphodynamic characteristics (velocity, depth, substratum) were observed simultaneously. The presence of fish was checked by using two special electric fishing techniques: (1) casting the anode ahead of the operator for a sudden immobilization of fish; and (2) connecting previously immersed electrodes on the riverbed. Curves have been plotted for velocity and depth parameters in each river at each season by analyzing the frequency of appearance of fish at different stages of development in the different habitats. These curves do not vary greatly from one river to the next and the differences between seasons are not very significant. Single curves have thus been plotted by grouping the data from the different series of measurements. The curves obtained for the velocity parameter are very close to those proposed by Bovee (Instream Flow Incremental Method) and reveal that the fishes have a preference for low velocities, regardless of their stage of development. As shown by the Bovee curves, the preference obtained for the depth parameter is related to the stage of development; shallow waters are much preferred by fry and juveniles but are not greatly frequented by adults. This study seems to confirm the existence of a real environmental preference among brown trout, indicating that the Instream Flow Incremental Method can be used for French 1st category streams. (Author's abstract)
W89-11720

ORINOCO RIVER: A REVIEW OF HYDROBIOLOGICAL RESEARCH,
Fundacion La Salle de Ciencias Naturales, San Felix (Venezuela).
For primary bibliographic entry see Field 2E.
W89-11726

REVIEW OF THE SCHISTOSOMIASIS RISK IN SOUTH AFRICAN DAMS,
Research Inst. for Diseases in a Tropical Environment, Nelspruit (South Africa).
For primary bibliographic entry see Field 6G.
W89-11749

DYNAMICS OF DISSOLVED ORGANIC CARBON IN FORESTED AND DISTURBED CATCHMENTS, WESTLAND, NEW ZEALAND: 1. MAIMAI.
McGill Univ., Montreal (Quebec). Dept. of Geography.
For primary bibliographic entry see Field 4C.
W89-11772

DYNAMICS OF DISSOLVED ORGANIC CARBON IN FORESTED AND DISTURBED CATCHMENTS, WESTLAND, NEW ZEALAND: 2. LARRY RIVER.
McGill Univ., Montreal (Quebec). Dept. of Geography.
For primary bibliographic entry see Field 4C.
W89-11773

CARBON CONTENT OF SEDIMENTS OF SMALL RESERVOIRS.
Agricultural Research Service, Beltsville, MD. Hydrology Lab.
J. C. Ritchie.
Water Resources Bulletin WARBAQ, Vol. 25, No. 2, p 301-308, April 1989. 4 fig, 6 tab, 16 ref.

Descriptors: *Limnology, *Sediments, *Reservoirs, *Lake sediments, *Carbon, Cycling nutrients, Statistical studies, Organic carbon, Watersheds, Reservoir silting, Sedimentation, Sediment contamination.

Carbon content was measured in sediments deposited in 58 small reservoirs across the United States. Reservoirs varied from 0.2 to 4000 sq km in surface area. The carbon content of sediment ranged from 0.3% to 5.6%, with a mean of 1.9 +or-1.1%. No significant differences between the soil and sediment carbon content were found using a paired t-test or ANOVA. The carbon content of sediments

in reservoirs was similar to the carbon content of surface soils (0-10 cm) in the watershed, except in watersheds with shrub or steppe (desert) vegetation. Based on the sediment accumulation rates measured in each reservoir, the calculated organic carbon accumulation rates among reservoirs range from 26 to 3700 g C/sq m/yr, with a mean of 675 +or-739 g C/sq m/yr. The carbon content and accumulation rates were highest in sediments from grasslands watersheds. High variability was found in carbon content, carbon accumulation, and sediment accumulation rates due to individual watershed and reservoir characteristics rather than to any broad physiographic patterns. The carbon accumulation rates in these reservoir sediments indicate that reservoir sediments could be a significant sink for organic carbon. (Author's abstract)
W89-11791

COORDINATION OF PUBLIC AND PRIVATE ACTION: A CASE STUDY OF LAKE RESTORATION.
Florida Univ., Gainesville. Dept. of Food and Resource Economics.
For primary bibliographic entry see Field 5G.
W89-11792

MANGANESE OXIDATION MODEL FOR RIVERS,
Geological Survey, Doraville, GA.
For primary bibliographic entry see Field 5B.
W89-11798

PHYSICAL HABITAT USE BY LOACH MINNOW, TIAROGA COBITIS (PISCES: CYPRINIDAE), IN SOUTHWESTERN DESERT STREAMS.
Rocky Mountain Forest and Range Experiment Station, Tempe, AZ. Forestry Sciences Lab.
For primary bibliographic entry see Field 6G.
W89-11810

INVASION OF LAKE TAUPO BY THE SUBMERGED WATER WEED LAGAROSIPHON MAJOR AND ITS IMPACT ON THE NATIVE FLORA,
Department of Scientific and Industrial Research, Taupo (New Zealand). Taupo Research Lab.
C. Howard-Williams, and J. Davies.
New Zealand Journal of Ecology NZJED6, Vol. 11, p 13-19, 1988. 4 fig, 1 tab, 21 ref.

Descriptors: *New Zealand, *Lakes, *Submerged plants, *Biological pollution, *Aquatic weeds, Littoral zone, Lake Taupo, Colonization.

The waterweed Lagarasiphon major (Hydrocharitaceae) was first recorded in Lake Taupo, New Zealand in 1966, and by 1979 it had occupied most of the potentially colonizable sites in the lake. The distribution, abundance and growth forms of L. major in Lake Taupo are examined and the effects of this plant on native aquatic vegetation are assessed. Studies involved underwater mapping of the 161 km length of littoral zone of the lake and the detailed analyses at 42 sites around the lake at which L. major biomass, height and density were measured together with the species composition of each site. Five growth forms of L. major were identified, ranging from absent to beds of continuous cover greater than one meter in height. The relationship between these growth forms and height and biomass was established. Height and biomass were negatively related to fetch, and positively related to littoral slope angle and proportion of fine sediment. The number of native species decreased markedly as L. major height and biomass increased. The most noticeable decrease was at 4 m depth. Large weed beds of L. major attract herbivorous birds and detrivores which also adversely affect the native flora. Until recently, the implications of the spread of L. major for the conservation of the indigenous flora has been overlooked. (Author's abstract)
W89-11818

METHOD FOR WETLAND FUNCTIONAL ASSESSMENT. VOLUME I: CRITICAL REVIEW AND EVALUATION CONCEPTS,
Center for Natural Areas, South Gardiner, ME.
P. R. Adamus, and L. T. Stockwell.
Federal Highway Administration Report No. FHWA-IP-82-23, March 1983. Final Report (Manual). 176p, 13 fig, 22 tab, 1008 ref, 2 append. DOT Contract DTFH61-80-C-00086.

Descriptors: *Surface-groundwater relations, *Data acquisition, *Wetlands, *Hydrologic systems, *Ecosystems, Groundwater recharge, Nutrients, Food chains, Fish, Highways, Environmental effects, Watersheds, Wildlife, Biological studies, Water quality, Drainage areas, Climates, Vegetation, Tidal range, Species diversity, Dissolved oxygen, Turbidity, Water level fluctuations, Flood-control-storage.

This manual presents a state-of-the-art review of wetland functions. Functions covered include: groundwater recharge and discharge, flood storage, and desynchronization, shoreline anchoring and dissipation of erosive forces, sediment trapping, nutrient retention and removal, food chain support (detrital export), habitat for fish and wildlife, and active and passive recreation. The manual covers all wetland types in the 48 coterminous states, and uses the US Fish and Wildlife Service definition and classification system. It examines the validity, interactions, and possible significance thresholds for the functions, as well as documenting their underlying processes. With appropriate qualifying information, wetland types are ranked for each function. Wetland types ideal for each function are identified and illustrated. Potential impacts of highways upon each function are described and, where available, possible thresholds are given. Factors which regulate impact magnitude, such as location, design, watershed erodibility, flushing capacity, basin morphology, biotic sensitivity (resistance and resilience), recovery capacity, and refugia, are explained. Cumulative impacts and social factors affecting wetland significance are discussed. Effects of the following factors on wetland function are documented: contiguity, shape, fetch, surface area, area of watershed and drainage area, stream order, gradient, land cover, soils, depositional environment, climate, wetland system, vegetation form, substrate, salinity, pH, hydroperiod, water level fluctuations, tidal range, scouring, velocity, depth, width, circulation, pool-riffle ratio, vegetation density, flow pattern, interspersion, human disturbance, turbidity, alkalinity, dissolved oxygen, temperature, and biotic diversity. (See also W89-11887) (Author's abstract)
W89-11886

METHOD FOR WETLAND FUNCTIONAL ASSESSMENT. VOLUME II: FHWA ASSESSMENT METHOD,
Center for Natural Areas, South Gardiner, ME.
P. R. Adamus.
Federal Highway Administration Report No. FHWA-IP-82-24, March 1983. Final Report (Manual). 134p, 21 fig, 9 tab, 223 ref, append. DOT Contract DTFH61-80-C-00086.

Descriptors: *Wetlands, *Surveys, *Data acquisition, *Hydrologic systems, *Estuaries, *Ecosystems, Nutrients, Food chains, Environmental effects, Marine environment, Rivers, Lakes, Primary productivity, Data acquisition, Waterfowl, Flood-control-storage.

The manual provides the Federal Highway Administration (FHWA) rapid assessment procedure for screening functional values of wetlands. Functions covered include groundwater recharge and discharge, flood storage and desynchronization, shoreline anchoring and dissipation of erosive forces, sediment trapping, nutrient retention and removal, food chain support (detrital export), habitat for fish and wildlife, and active and passive recreation. The method can be used for all wetland types in the 48 coterminous states, and uses of the U.S. Fish and Wildlife Service definition and classification scheme. The assessment method is qualitative and not based on a series of weights and scores. It can be used to evaluate the importance of a single wetland or to compare several wetlands. It may be applied to choices regarding reasonableness of mitigation, replacement ratios for compensation wetlands, priorities for site-specific research, and route alignment. It can also be used for decisions regarding route widening or realignment. It can use 'office-type' data, data from cursory field visits, and/or detailed data, with corresponding increase in the predictive validity. Social as well as scientific factors are incorporated, and a framework is also provided for inclusion of mitigation cost data. Contributions of wetlands versus their basins are differentiated, and seasonal variability is taken into account. Net primary productivity data for wetland plants is catalogued by region. Wetland type preferences of all harvested waterfowl, 120 species of other wetland-dependent birds, 133 marine fishes and invertebrates of commercial or sport value, and 95 freshwater or anadromous fishes of commercial or sport value, are described. The method can also be used to evaluate functions of many rivers and lakes. (See also W89-11886) (Author's abstract)
W89-11887

WATER QUALITY MANAGEMENT FOR RESERVOIRS AND TAILWATERS. REPORT 1: IN-RESERVOIR WATER QUALITY MANAGEMENT TECHNIQUES.
Kent State Univ., OH. Dept. of Biological Sciences.
For primary bibliographic entry see Field 5G.
W89-11997

WETLANDS AND FLOODPLAINS ASSESSMENTS FOR SUPERFUND SITES UNDER SARA.
Jordan (Edward C.) Co., Inc., Wakefield, MA.
A. H. Baldwin, and M. J. Donato.
IN: HWHM 88: Hazardous Wastes and Hazardous Materials. Proceedings of the 5th National Conference held April 19-21, 1988, Las Vegas, Nevada. 1988. p 332-336, 2 fig, 5 ref. EPA Contract 68-01-7250.

Descriptors: *Wetlands, *Flood plains, *Water pollution prevention, *Project planning, *Superfund, Regulations, Waste disposal, Ecological effects, Case studies.

The development and evaluation of alternatives for cleanup of Superfund hazardous waste sites often is affected by wetlands and floodplains issues. EPA policy is that a floodplains and wetlands assessment must be incorporated into the planning of the remedial action. Superfund Amendments and Reauthorization Act of 1986 (SARA) places more emphasis on protection of the natural environment than previous laws and sets forth enforceable cleanup standards. A wetlands and floodplains assessment methodology for Superfund sites which meets the requirements of SARA and cost-effectively supports engineering decisions in the remedial design is described. Wetlands and floodplains assessment techniques traditionally have focused on evaluation of development-related projects; the methodology presented is designed to address the requirements associated with a contaminated site. The wetlands and floodplains assessment process includes identification of wetlands or floodplains, characterization of wetland flora and fauna, assessment of wetland functional attributes, evaluation of current and future impacts to wetland ecosystems and floodplains and evaluation of beneficial and adverse effects of remedial alternatives. If adverse impacts are expected, mitigative measures (e.g., wetland replacement) must be developed. A wetlands and floodplains assessmet performed at the Landfill and Resource Recovery site in North Smithfield, Rhode Island is presented to illustrate implementation of the proposed methodology. (See also W89-12002) (Author's abstract)
W89-12046

MICROCHEMICAL ANALYSIS OF FISH HARD PARTS FOR RECONSTRUCTING HABITAT USE: PRACTICE AND PROMISE.
Oak Ridge National Lab., TN. Environmental Sciences Div.
C. C. Coutant.
Available from the National Technical Information Service, Springfield, VA 22161, as DE88-009055.

Price codes: A03 in paper copy, A01 in microfiche. Report No. CONF-8806114--1, (1988). 19p, 42 ref. DOE Contract DE AC05-84OR21400.

Descriptors: *Aquatic habitats, *Animal tissues, *Bioindicators, *Chemical analysis, *Fish, *Measuring instruments, Ecosystems, Fisheries, History, Growth, Data acquisition, Spectroscopy, Lasers.

This paper describes and evaluates the application of several microscale chemical analysis techniques that allow the chemical record imbedded in daily and seasonal growth banding of biological skeletal materials to be used as an indicator of habitat history. Electron microprobe techniques offer the ability to scan many elements simultaneously but with low quantitative resolution; this technique has been applied to fish tissues by investigators. Laser-based techniques, which were developed at Oak Ridge National Laboratory for use in the physical sciences, offer extremely high spatial and quantitative resolution for elements or isotopes, but the elements must be analyzed one at a time. They include: (1) ion beam sputtering; (2) laser ablation; (3) resonance ionization spectroscopy (RIS) without mass analysis; (4) RIS with mass analysis; and (5) laser-induced fluorescence. Applications envisioned for fisheries research include differentiating freshwater, saltwater, and estuarine habitation of migratory striped bass; chemically marking hatchery-raised fish; and determining the exposure history of fish to water pollutants. (Author's abstract)
W89-12100

PRELIMINARY ANALYSIS OF NUTRIENT MONITORING DATA FOR THE SUSQUEHANNA RIVER AND SELECTED TRIBUTARIES: JANUARY 1, 1985-DECEMBER 31, 1987.
Susquehanna River Basin Commission, Harrisburg, PA.
For primary bibliographic entry see Field 2E.
W89-12104

PLAN FOR STUDY: RESPONSE OF THE HABITAT AND BIOTA OF THE INNER NEW YORK BIGHT TO ABATEMENT OF SEWAGE SLUDGE DUMPING.
National Marine Fisheries Service, Woods Hole, MA. Northeast Fisheries Center.
For primary bibliographic entry see Field 5G.
W89-12111

WATER MANAGEMENT OF RESERVOIRS.
Ceske Vysoke Uceni Technicke v Praze. Faculty of Civil Engineering and Architecture.
For primary bibliographic entry see Field 4A.
W89-12116

COMPENDIUM OF 45 TROUT STREAM HABITAT DEVELOPMENT EVALUATIONS IN WISCONSIN DURING 1953-1985,
Wisconsin Dept. of Natural Resources, Waupaca. Trout Resource Unit.
R. L. Hunt.
Technical Bulletin No. 126, 1988. 80p, 47 fig, 56 tab, 20 ref, append. Federal Aid in Fish Restoration Act Project F-83-R.

Descriptors: *Aquatic habitats, *Fish management, *Trout, *Streams, *Wisconsin, *Ecosystems, Biomass, Fish populations, Growth, Vegetation, Water currents, Sport fishing, Riparian vegetation, Population density, Fish harvest, Fish behavior, Vegetation effects, Statistical analysis.

A standard case history format was devised to summarize 45 trout stream habitat evaluations carried out by Wisconsin Department of Natural Resources (DNR) fishery management and research biologists, on 41 streams distributed among 29 counties during 1953-85. Data were gathered from 55 treatment zones (TZs) averaging 0.84 mile long and 20 reference zones (RZs) averaging 0.74 mile long. Wild trout were dominant or solely present in 49 of the 55 TZs. 'Success' of each project was judged on the basis of percentage changes within TZs for each of 6 possible variables standardized to 'per mile' quantities. These 6 variables were: total number of trout, number 6 inches or larger (legal size), number 10 inches or larger (quality size), total biomass, angler hours, and angler harvest. Two arbitrary levels of success were set: level 1 = postdevelopment variable increases of 25% or more, and level 2 = increased of 50% or more. Approximately 60% of the quantified changes in the 6 standard variables exceeded success level 1 after habitat development; 43% exceeded success level 2. Postdevelopmental abundance of legal-sized trout was at least 25% greater than predevelopment abundance in 59% of the TZs where this variable was quantified. For projects involving allopatric populations of wild brook trout (Salvelinus fontinalis) or wild brown trout (Salmo trutta), success rates were similar, but in sympatric situations brown trout responded much more positively than did brook trout to habitat development. The 'Wisconsin-style' bank habitat development technique cover and current deflector category generally produced the best success rates. Stream bank debrushing, sometimes in combination with installation of brush bundles, was very effective in a few TZs but scored low in overall success rates for all 9 TZs. Projects initiated after 1977 (post-trout-stamp era) were slightly more successful than projects initiated prior to 1977. (Lantz-PTT)
W89-12131

2I. Water In Plants

CHANGES IN GAS EXCHANGE CHARACTERISTICS AND WATER USE EFFICIENCY OF MANGROVES IN RESPONSE TO SALINITY AND VAPOUR PRESSURE DEFICIT.
Australian Inst. of Marine Sciences, Townsville.
B. F. Clough, and R. G. Sim.
Oecologia OECOBX, Vol. 79, No. 1, p 38-44, April 1989. 3 fig, 5 tab, 29 ref.

Descriptors: *Vapor pressure, *Mangroves, *Estuaries, *Photosynthesis, Water use efficiency, *Salinity, Gas exchange, Stomatal transpiration, Carbon dioxide, Moisture stress, Relative humidity, Aridity, Australia, Papua New Guinea.

Measurements were made of the photosynthetic gas exchange properties and water use efficiency of 19 species of mangrove in 9 estuaries with different salinity and climatic regimes in northeastern Australia and Papua New Guinea. Stomatal conductance and CO2 assimilation rates differed significantly between species at the same locality, with the salt-secreting species, Avicennia marina, consistently having the highest CO2 assimilation rates and stomatal conductances. Proportional changes in stomatal conductance and CO2 assimilation rate resulted in constant and similar intercellular CO2 concentrations for leaves exposed to photon flux densities above 800 micromol/sq m/s in all species at a particular locality. In consequence, all species at the same locality had similar water use efficiencies. There were, however, significant differences in gas exchange properties between different localities. Stomatal conductance and CO2 assimilation rate both decreased with increasing salinity and increasing leaf to air vapour pressure deficit. The slope of the relationship between assimilation rate and stomatal conductance increased, while intercellular CO2 concentration decreased, with increasing salinity and with decreasing ambient relative humidity. These results indicate that the water use efficiency of mangroves increases with increasing environmental stress, in this case aridity, thereby maximizing photosynthetic carbon fixation while minimizing water loss. (Author's abstract)
W89-11199

MODEL FOR THE ESTIMATION OF ANNUAL PRODUCTION RATES OF MACROPHYTE ALGAE,
Universidade Nova de Lisboa (Portugal). Faculdade de Ciencias e Tecnologia.
For primary bibliographic entry see Field 2L.
W89-11365

SEASONAL PLANT WATER RELATIONS IN A SOUTH AFRICAN MANGROVE SWAMP.
Durban-Westville Univ. (South Africa). Dept. of Botany.
For primary bibliographic entry see Field 2L.
W89-11366

PRIMARY PRODUCTION IN A SHALLOW EUTROPHIC LAKE DOMINATED ALTERNATIVELY BY PHYTOPLANKTON AND BY SUBMERGED MACROPHYTES.
Otago Univ., Dunedin (New Zealand). Dept. of Zoology.
For primary bibliographic entry see Field 2H.
W89-11367

VERTICAL DISTRIBUTION AND RESOURCE ALLOCATION OF RUPPIA MARITIMA L. IN A SOUTHERN BRAZILIAN ESTUARY.
Fundacao Univ., Rio Grande (Brazil). Lab. de Botanica Marinha.
For primary bibliographic entry see Field 2L.
W89-11369

SALINITY AND FLOODING LEVEL AS DETERMINANTS OF SOIL SOLUTION COMPOSITION AND NUTRIENT CONTENT IN PANICUM HEMITOMUM.
Louisiana State Univ., Baton Rouge. Lab. for Wetland Soils and Sediments.
For primary bibliographic entry see Field 2L.
W89-11424

PHYSIOLOGICAL ROUTE TO INCREASED WATER USE EFFICIENCY IN ALFALFA,
New Mexico State Univ., Las Cruces. Dept. of Biology.
For primary bibliographic entry see Field 3F.
W89-11487

RESPONSE OF WHITE CLOVER (TRIFOLIUM REPENS L.) AND RYEGRASS (LOLIUM PERENNE L.) TO ACID RAIN IN SITUATIONS OF SPECIES INTERFERENCES.
Institute of Terrestrial Ecology, Bangor (Wales). Bangor Research Station.
For primary bibliographic entry see Field 5C.
W89-11527

WATER RELATIONS AND GROWTH RESPONSES OF UNIOLA PANICULATA (SEA OATS) TO SOIL MOISTURE AND WATER-TABLE DEPTH.
Louisiana State Univ., Baton Rouge. Lab. for Wetland Soils and Sediments.
For primary bibliographic entry see Field 2G.
W89-11529

EFFECTS OF NUTRIENT AVAILABILITY ON WATER HYACINTH STANDING CROP AND DETRITUS DEPOSITION.
Reedy Creek Utilities Co., Inc., Lake Buena Vista, FL.
T. A. DeBusk, and F. E. Dierberg.
Hydrobiologia HYDRB8, Vol. 174, No. 2, p 151-159, April 15 1989. 4 fig, 4 tab, 16 ref.

Descriptors: *Nutrient requirements, *Water hyacinth, *Cycling nutrients, *Detritus, *Decomposing organic matter, *Standing crops, Biomass, Aquatic plants, Nutrient removal, Bioaccumulation, Aquatic environment, Ecosystems.

Nutrient-enriched water hyacinths were stocked in outdoor tanks and cultured under both high nutrient (HN) and low nutrient (LN) regimes for 10 months. Seasonal changes in standing crop biomass and morphology of LN water hyacinths were similar to those of HN water hyacinths, despite a tenfold between-treatment difference in N availability and a two-fold difference in average plant N concentration (1.0 and 2.0 percent for LN and HN plants, respectively). Tissue N accumulated by the LN plants prior to stocking helped support standing crop development during the 10 month study. In both HN and LN treatments, the rate of detritus deposition, or the sloughing of dead plant tissues

from the mat, was lower than the actual detritus production rate because of the retention of dead 'aerial' tissues (laminae and petioles) in the floating mat. The retention of laminae and petioles may serve as a nutrient conservation mechanism, since nutrients released from decomposing tissues in the mat-water environment may be assimilated by adjacent plants. The average rate of detritus deposition (both dry matter and N) by LN water hyacinths (1.2 g dry wt./sq m-day and 0.017 g N /sq m-day) was lower than that of HN plants (3.0 g dry wt. /sq m-day and 0.075 g N/sq m-day) during the study. Low detrital N losses by the water hyacinth probably enhance the survival of this species in aquatic systems that receive nutrient inputs intermittently. (Author's abstract)
W89-11557

VEGETATION PATTERNS IN JAMES BAY COASTAL MARSHES: II. PHYSIOLOGICAL ADAPTATION TO SALT-INDUCED WATER STRESS IN THREE HALOPHYTIC GRAMINOIDS.
McMaster Univ., Hamilton (Ontario). Dept. of Biology.
For primary bibliographic entry see Field 2L.
W89-11565

ACCOUNT OF THE HISTORY, FLORA AND VEGETATION OF NATURE RESERVE 'HET MOLENVEN', PROVINCE OF OVERIJSSEL, THE NETHERLANDS,
Amsterdam Univ. (Netherlands). Hugo de Vries Lab.
T. C. M. Brock, T. van der Hammen, P. C. van der Molen, E. T. H. Ran, and G. B. A. van Reenen.
Proceedings of the Koninklijke Nederland se Akademie van Wetenschappen. Series B: Palaeontology PDNBE3, Vol. 92, No. 1, p 1-46, March 20, 1989. 12 fig, 9 tab, 46 ref, append.

Descriptors: *Geomorphology, *Vegetation, *Wetlands, *Succession, *The Netherlands, History, Restoration, Riparian vegetation, Management, Myrica, Cyperaceae, Juncaceae, Phragmites, Geologic history, Groundwater level.

The Molenven Nature Reserve is in a former stream valley of Pleniglacial age that became blocked by cross-ridges of Younger Cover Sand during the Late Glacial. In the course of the Holocene the shallow lake that had developed in the blocked stream-bed was filled up by gyttja and peat deposits. Peat digging by farmers, probably mainly during the 19th century, returned the area to an open shallow lake. Vegetation characterized by Myrica, Cyperaceae, Juncaceae and Phragmites became common on shallow sites and temporarily inundated soils while on the sandy lake bottom a I ittorellion vegetation became established. At that time the lake was surrounded by heathland. Around 1900, several changes in land exploitation by man altered environmental conditions fundamentally, and in response, vegetation succession started to proceed rapidly. The digging of a ditch resulted in the input of nutrient-rich water and drainage of the wetland, that caused an expansion of reed, shrubs and trees. On the higher grounds Pinus sylvestris was introduced locally by man, while the remaining heathland sites gradually became invaded by birch. Since 1959, the conservancy policy focused on the restoration of the 'original' (pre-ditch) precipitation-dominated hydrology of the reserve and on the avoidance of external anthropogenic influences. This management strategy aims at the development of natural succession on both wet and dry grounds, leading to 'climax' vegetation. In recent years 15 vegetation types, that can be classified into the Potametea, Phragmitetea, Franguletea, Alnetea glutinosae or Quercetea robori-petraea, have been described for the reserve. The differentiation of the various communities coincides with differences in relative water-table height, pH, trophic status of the sediment, the type of soil and the history of the sites. (Author's abstract)
W89-11604

PEAT CHEMISTRY OF A CONTINENTAL MIRE COMPLEX IN WESTERN CANADA.
Alberta Univ., Edmonton. Dept. of Botany.
For primary bibliographic entry see Field 2H.
W89-11615

EFFECTS OF ISOLATION ON THE WATER STATUS OF FOREST PATCHES IN THE BRAZILIAN AMAZON.
Missouri Botanical Gardens, St. Louis.
For primary bibliographic entry see Field 4C.
W89-11819

NUTRIENT CONTENT OF BULK PRECIPITATION IN SOUTH-CENTRAL JAVA, INDONESIA.
Vrije Univ., Amsterdam (Netherlands). Dept. of Hydrogeology and Geographical Hydrology.
L. A. Bruijnzeel.
Journal of Tropical Ecology JTECEQ, Vol. 6, No. 2, p 187-202, May 1989. 5 tab, 56 ref. WOTRO grant nos. W 76-45 and WR 84-221.

Descriptors: *Chemistry of precipitation, *Soil-water-plant relationships, *Precipitation, *Indonesia, *Nutrients, Chemical composition, Rainfall.

The chemical composition of bulk precipitation was studied for a period totalling 18 months between 1975 and 1978 at a high rainfall site in central Java. The following elements were determined: (1) calcium, (2) magnesium, (3) sodium, (4) potassium, (5) nitrate-nitrogen, (6) chlorine, (7) phosphate-phosphorous, (8) silicon, (9) aluminum, (10) iron, (11) manganese, and (11) pH. Ammoniacal nitrogen, total nitrogen and sulfate-sulfur were determined during the four weeks in May 1983. Concentrations of all elements rose dramatically during the exceptionally severe dry season of 1977 which may have caused accession rates for some nutrients to be overestimated by about 10%. Results are explained in terms of prevailing wind directions and proximity to, or absence of, particular solute sources. Most elements exhibited intermediate concentrations when compared with data for other humid tropical locations; sodium and perhaps nitrogen were on the low side and pH on the high side of the spectrum. Annual accession rates at the study site were considerable by pantropical standards, mainly as a result of high rainfall totals. Comparing accession rates with 25-year-average nutrient immobilization rates in stemwood of local plantations of Pinus merkusii Jungh. et de Vr. and Agathis dammara Warb. showed atmospheric inputs of magnesium and potassium to be high enough to account for losses of these elements in stemwood removal. Corresponding figures for nitrogen were 90% (Pinus) and 50% (Agathis), and for calcium and phosphorous, 60% and 40% respectively (both species). (Author's abstract)
W89-11820

2J. Erosion and Sedimentation

KINETICS OF ACETATE AND METHANOL CONVERSION INTO METHANE IN EUTROPHIC SEDIMENTS AND ITS APPLICATION IN ANAEROBIC SYSTEMS.
Max-Planck-Inst. fuer Limnologie zu Ploen (Germany, F.R.). Abt. Mikrobenoekologie.
For primary bibliographic entry see Field 2H.
W89-11078

SUBMERSIBLE STUDIES OF CURRENT-MODIFIED BOTTOM TOPOGRAPHY IN LAKE SUPERIOR.
Lamont-Doherty Geological Observatory, Palisades, NY.
For primary bibliographic entry see Field 2H.
W89-11181

SURFACE AND BENTHIC NEPHELOID LAYERS IN THE WESTERN ARM OF LAKE SUPERIOR, 1983.
Duke Univ., Beaufort, NC. Marine Lab.
For primary bibliographic entry see Field 2H.
W89-11182

SEDIMENT REWORKING AND TRANSPORT IN EASTERN LAKE SUPERIOR: IN SITU RARE EARTH ELEMENT TRACER STUDIES.
Wisconsin Univ.-Milwaukee. Center for Great Lakes Studies.
For primary bibliographic entry see Field 2H.
W89-11183

SUBMERSIBLE-DEPLOYED VIDEO SEDIMENT-PROFILE CAMERA SYSTEM FOR BENTHIC STUDIES.
Wisconsin Univ.-Milwaukee. Center for Great Lakes Studies.
For primary bibliographic entry see Field 7B.
W89-11184

GEOCHEMICAL PARTITIONING OF PB, ZN, CU, FE, AND MN ACROSS THE SEDIMENT-WATER INTERFACE IN LARGE LAKES.
Michigan State Univ., East Lansing. Dept. of Geological Sciences.
For primary bibliographic entry see Field 2K.
W89-11185

GEOCHEMISTRY OF RARE EARTH ELEMENTS IN BENTHIC LAYER PARTICULATE MATTER AND SEDIMENTS OF LAKE SUPERIOR.
Michigan State Univ., East Lansing. Dept. of Geological Sciences.
For primary bibliographic entry see Field 2K.
W89-11186

PORE WATER PROFILES AND EARLY DIAGENESIS OF MN, CU, AND PB IN SEDIMENTS FROM LARGE LAKES.
Michigan State Univ., East Lansing. Dept. of Geological Sciences.
For primary bibliographic entry see Field 2H.
W89-11187

PCBS AND PAHS AS TRACERS OF PARTICULATE DYNAMICS IN LARGE LAKES.
Minnesota Univ., Minneapolis. Dept. of Civil and Mineral Engineering.
For primary bibliographic entry see Field 2H.
W89-11188

VARIATIONS IN SEDIMENT ACCUMULATION RATES AND THE FLUX OF LABILE ORGANIC MATTER IN EASTERN LAKE SUPERIOR BASINS.
Wisconsin Univ.-Milwaukee. Center for Great Lakes Studies.
For primary bibliographic entry see Field 2H.
W89-11189

DISTRIBUTIONS OF MANGANESE, IRON, AND MANGANESE-OXIDIZING BACTERIA IN LAKE SUPERIOR SEDIMENTS OF DIFFERENT ORGANIC CARBON CONTENT.
Wisconsin Univ.-Milwaukee. Center for Great Lakes Studies.
For primary bibliographic entry see Field 2H.
W89-11190

RELATIVE VALUES OF OXYGEN, NITRATE, AND SULFATE TO TERMINAL MICROBIAL PROCESSES IN THE SEDIMENTS OF LAKE SUPERIOR.
Michigan State Univ., Hickory Corners. W.K. Kellogg Biological Station.
For primary bibliographic entry see Field 2H.
W89-11191

METHANE OXIDATION IN LAKE SUPERIOR SEDIMENTS.
Wisconsin Univ.-Milwaukee. Center for Great Lakes Studies.
For primary bibliographic entry see Field 2H.
W89-11192

IN SITU STUDIES OF ORGANISM-SEDIMENT RELATIONSHIPS IN THE CARIBOU ISLAND BASIN, LAKE SUPERIOR.
Wisconsin Univ.-Milwaukee. Dept. of Geological Sciences.
For primary bibliographic entry see Field 2H.
W89-11193

BIOGEOCHEMISTRY OF MARIANA ISLANDS COASTAL SEDIMENTS: TERRESTRIAL INFLUENCE ON DELTA-C13, ASH, CACO3, AL, FE, SI AND P.
Guam Univ., Agana. Marine Lab.
E. A. Matson.
Coral Reefs CORFDL, Vol. 7, No. 4, p 153-160, January 1989. 4 fig, 4 tab, 56 ref.

Descriptors: *Biochemistry, *Islands, *Coastal waters, *Seepage, *Limnology, *Reefs, *Lagoons, *Marine sediments, *Geochemistry, *Carbon, *Ash, *Aluminum, *Iron, *Silicon, *Phosphorus, *Carbonates, Organic matter, Aquifers, Seepage,Runoff, Eddies, Water currents, Tropical regions, Guam, Saipan.

Stable C isotope ratios (delta-C13), percentages of organic matter, and HCl insoluble ash and soluble carbonates, extractable Fe, Al, Si and P were used to determine the distribution and accumulation of terrestrial material in reef-flat moats and lagoons of two high islands (Guam and Saipan) in the western tropical Pacific. Carbonate sediments of a reef-flat moat infiltrated by seepage of aquifer waters (but without surface runoff) were depleted in both P (by 38%) and C13 (by 41%) and enriched in Si (by 100%) relative to offshore lagoon sediments. Fe and ash accumulated in depositional regimes regardless of the occurrence of runoff but was depleted from coarse-grained carbonates in turbulent regimes. Al (>10 to 20 micromol/g), Fe (>1 to 3 micromol/g) and ash (>0.5%) indicated terrigenous influence which was corroborated by depletions in both C13 and P. Low-salinity geochemical segregation, natural biochemical accumulation, as well as long-shore currents and eddies help sequester these materials nearshore. (Author's abstract)
W89-11206

RANDOM SPATIAL NETWORK MODEL BASED ON ELEMENTARY POSTULATES,
Geological Survey, Lakewood, CO.
For primary bibliographic entry see Field 2E.
W89-11250

DUNE MIGRATION IN A STEEP, COARSE-BEDDED STREAM.
Cascades Volcano Observatory, Vancouver, WA.
R. L. Dinehart.
Water Resources Research WRERAO, Vol. 25, No. 5, p 911-923, May 1989. 11 fig, 4 tab, 30 ref.

Descriptors: *Channel morphology, *Alluvial channels, *Dunes, *Sediment transport, *Bottom sediments, *Bed load, *Streamflow, Fluid mechanics, Wave height, Flow characteristics, Sand, Gravel, Wave action, Flow velocity.

During 1986 and 1987, migrating bed forms composed of coarse sand and fine gravel were documented in the North Fork Toutle River at Kid Valley, Washington, at flow velocities ranging from 1.6 to 3.4 m/s and depths of 0.8 to 2.2 m. The bed forms (predominantly lower regime dunes) were studied with a sonic depth sounder transducer suspended in the river at a stationary point. Twelve temporal depth-sounding records were collected during storm runoff and nearly steady, average streamflow, with record durations ranging from 37 to 261 min. Waveform height was defined by dune front heights, which ranged from 12 to 70 cm. A weak correlation between flow depth and the standard deviation of bed elevation was noted. Dune front counts and spectral analyses of the temporal records showed that dune crests passed the observation point every 2 to 5 min. Dunes were often superposed on larger bed forms with wave periods between 10 and 30 min. Gradual changes in waveform height and periodicity occurred over several hours during storm runoff. The processes of dune growth and decay were both time-dependent and affected by changes in streamflow. Rates of migration for typical dunes were estimated to be 3 cm/s, and dune wavelengths were estimated to be 6 to 7 m. (Author's abstract)
W89-11259

ESTIMATING CONSTITUENT LOADS.
Geological Survey, Reston, VA.
T. A. Cohn, L. L. DeLong, E. J. Gilroy, R. M. Hirsch, and D. K. Wells.
Water Resources Research WRERAO, Vol. 25, No. 5, p 937-942, May 1989. 6 fig, 1 tab, 19 ref.

Descriptors: *Bed load, *Bottom sediments, *Model studies, *Regression analysis, *Sedimentation, *Load distribution, Statistical models, Statistical methods, Comparison studies, Sediment transport, Model testing.

The problem of retransformation bias, which can arise when log linear regression models are used to estimate sediment or other constituent loads, has recently been addressed. In some cases, the bias can lead to underestimation of constituent loads by as much as 50 percent, and several procedures have been suggested for reducing or eliminating it. However, some of the procedures recommended for reducing the bias can actually increase it. The bias and variance of three procedures that can be used with log linear regression models are compared: the traditional rating curve estimator, a modified rating curve method, and a minimum variance unbiased estimator (MVUE). Analytical derivations of the bias and efficiency of all three estimators are presented. It is shown that for many conditions, the traditional and the modified estimator can provide satisfactory estimates. However, other conditions exist where they have substantial bias and a large mean square error. These conditions commonly occur when sample sizes are small, or when loads are estimated during high-flow conditions. The MVUE, however, is unbiased and always performs nearly as well or better than the rating curve estimator or the modified estimator provided that the hypothesis of the log linear model is correct. Since an efficient unbiased estimator is available, there seems to be no reason to employ biased estimators. (Author's abstract)
W89-11261

EVALUATION OF A LINEAR BANK EROSION EQUATION.
Delaware Univ., Newark. Dept. of Geology.
J. E. Pizzuto, and T. S. Meckelnburg.
Water Resources Research WRERAO, Vol. 25, No. 5, p 1005-1013, May 1989. 11 fig, 4 tab, 37 ref.

Descriptors: *Erosion, *Bed load, *Bottom sediments, *Sediment transport, *Sedimentation, *Bank erosion, *Erosion rates, Mathematical equations, Channel erosion, Flow velocity, Sedimentation rates, Dunes, Performance evaluation, Maple trees.

Field surveys and aerial photographs were used to measure the rate of migration of a bend of the Brandywine Creek near Chadds Ford, Pennsylvania. Velocities near the bank were measured in the field during high flows and also estimated by solving a form of the St. Venant equations. Engineering properties of the bank soils and the spatial density of trees growing along the bank were also measured. The data indicate that rates of bank migration are linearly related to the magnitude of the near-bank velocity. If the St. Venant equations are used to estimate the near-bank velocity, the data also suggest that erosion rates are proportional to the near-bank velocity minus the reach-averaged velocity. In addition, rates of bank migration are reduced where the density of silver maples (Acer saccharinum) is high. Boxelder (Acer negundo) and white ash (Fraxinus americana) are also found along the bend, but these species do not noticeably influence rates of bank migration. (Author's abstract)
W89-11267

CHANNEL LENGTH-MAGNITUDE FORMULA FOR RANDOM NETWORKS: A SOLUTION TO MOON'S CONJECTURE,
Oregon State Univ., Corvallis. Dept. of Mathematics.
E. Waymire.
Water Resources Research WRERAO, Vol. 25, No. 5, p 1049-1050, May 1989. 8 ref. ARO grants 26220-GS and NSF grant DMS-8801466.

Descriptors: *Geomorphology, *Drainage patterns, *Channel flow, *Networks, *Hydrologic properties, *Mathematical studies, Topology, Noons conjecture, Mathematical equations.

Moon's conjecture is solved for the exact asymptotic formula for the expected length of the longest path in Shreve's random network for large magnitude (source number). The basic reason that the earlier results cannot completely resolve the problem of determining the exact asymptotic formula for the expected length of the longest path of a large number of sources in the topological random network model of Shreve is that for a network with random link lengths, the length of the longest path needs to coincide with the path having the maximum number of junctions. The problem is resolved by showing the reverse inequality to be asymptotically true, thus settling Moon's conjecture in the affirmative. An application of a general result of Kolchin is the basis for the proof of the resolution to the problem. (Friedmann-PTT)
W89-11271

PARTICLE SIZE ANALYSIS OF THE SEDIMENT SUSPENDED IN A PROGLACIAL STREAM: GLACIER DE TSIDJIORE NOUVE, SWITZERLAND.
Worcester Coll., Oxford (England). Dept. of Geography.
C. R. Fenn, and B. Gomez.
Hydrological Processes HYPRE3, Vol. 3, No. 2, p 123-135, April/June 1989. 8 fig, 1 tab, 29 ref.

Descriptors: *Glacial streams, *Particulate matter, *Suspended load, *Bottom sediments, *Switzerland, *Sediment distribution, Sediment concentration, Precipitation, Sedimentation, Snowmelt, Storm runoff, Silt.

Hourly, at-a-point samples of suspended sediment taken from the outflow stream of Glacier de Tsidjiore Nouve, Switzerland, over a 60 day sampling period (n = 1440) are shown to be dominantly composed of silt-sized particles. Particle size, SEM and XRD analyses indicate a subglacial provenance for the suspended sediment. Temporal variations in particle size and sorting correspond poorly to fluctuations in water discharge, being dominated by erratic hour-to-hour fluctuations and clockwise hysteresis over diurnal flow events. Examination of grain size and sorting dynamics over snowmelt-related and icemelt-related ablation events, during precipitation events, and during glacier drainage events enables some inferences to be drawn regarding sediment source areas and supply regimes. It is concluded that although the bulk of the suspended sediment in the proglacial stream of Glacier de Tsidjiore Nouvre is derived directly from subglacial sources (with occasional contributions from the valley train during rapid snowmelt and heavy rainfall periods), a portion of the suspended load undergoes intermittent 'flush-fall' transfer through the proglacial zone, which acts as a sediment source during rising flows and as a sink during periods of waning flow. (Author's abstract)
W89-11284

RECENT STROMATOLITES IN LAND-LOCKED POOLS ON ALDABRA, WESTERN INDIAN OCEAN.
Dundee Univ. (Scotland). Dept. of Geology.
C. J. R. Braithwaite, J. Casanova, T. Frevert, and B. A. Whitton.
Palaeogeography PPPYAB, Vol. 69, No. 3/4, p 145-165, March 1989. 23 fig, 4 tab, 42 ref.

Descriptors: *Magnesium, *Calcite, *Geologic formations, *Mineral water, *Algae, *Stromatolites, *Geochemistry, *Geomorphology, *Sedimentary petrology, Calcium compounds, Water chemistry, Porous media, Algae, Madagascar.

Stromatolites occurring in three areas of landlocked pools in Aldabra show distinctive morphologies, petrography and biological characteristics related both to water chemistry and the physical characteristics of sites. They are formed apparently by indirect precipitation of high-magnesium calcite in association with growths of cyanobacteria and Cladophora. The three contrasted areas are dominated, by Phormidium, Lyngbya and Pleurocapsa, by Entophysalis, Lyngbya and Pleurocapsa, and by Pleurocapsa, Dichothrix sypsophila and Schizothrix, reflecting an increasing concentration and increasing dissolved carbonate activity of pool waters. Centimeters to decimeters of carbonate encrustations are made up of irregular laminate columns, porous layered coatings of planar or cerebroid form and finely laminate branching columns. Laminae are typically alternations of dense and porous micrite. Although exclusively associated with cyanobacteria, calcification typically begins several millimeters beneath living cells, with few examples of carbonate-coated unicells or filaments. Micrite consists of randomly arranged particles of varying size, products of sparse homogeneous nucleatin followed by both overgrowth and dissolution. Coarse cements of contrasted morphologies develop within internal cavities, resembling the endostromatolites. Chemical data indicate that waters in all three pools are supersaturated with respect to calcite. This is adequate, but is not in itself sufficient, to bring about precipitation of carbonate, which is site-specific. Cyanobacteria are not directly calcified but metabolic activities may promote precipitation through mechanisms such as extraction of CO2(-) or by generation of specific organic molecules that promote nucleation, or colonies may provide a closed passive environment in which other bacteria or inorganic processes bring about crystallization. The precise path is not known but the reduction of possibilities carries implications both for the accretion of other stromatolites and the crystallization of carbonate in deposits such as tufas. (Author's abstract)
W89-11296

HYDROGEOLOGIC FACIES MODELS TO DELINEATE LARGE-SCALE SPATIAL TRENDS IN GLACIAL AND GLACIOFLUVIAL SEDIMENTS.
Wisconsin Univ.-Madison. Dept. of Geology and Geophysics.
M. P. Anderson.
Geological Society of America Bulletin BUGMAF, Vol. 101, No. 4, p 501-511, April 1989. 8 fig, 1 tab, 98 ref. NSF Grant no. ECE-8420864.

Descriptors: *Geohydrology, *Stratigraphy, *Sediments, *Hydrologic models, *Glacial sediments, *Glaciohydrology, Spatial distribution, Geohydrology.

Facies models are used to construct conceptual models of hydrogeological facies for glacial-meltwater-stream sediment and till. These hydrogeological facies models, which delineate large-scale trends in heteorogeneity, are appropriate for use in designing hydrogeologic field tests and for estimating input to regional ground-water flow and transport models. Meltwater-stream sediment includes outwash and stratified ice-contact deposits. The outwash hydrogeologic facies consists of a sheet of alluvium that becomes finer in the downgradient direction. The proximal section of the outwash deposit consists of intersecting sheets of gravel interbedded with thin deposits of sand. The medial section is characterized by interbedded sheets of sand and gravel. The distal portion consists of sand and finer material. Hydraulic conductivity for these hydrogeologic-facies assemblages will depend on site-specific conditions and can be estimated mathematically. Each facies is treated as a homogeneous, aniostropic hydrogeologic unit. The models conceptualize the hydrogeologic relationships among facies and illustrate one method of converting the apparent chaos in nature into an orderly system that can be used scientifically and modelled mathematically. The principles used to create conceptual models of hydrogeologic facies for these types of sediment can be extended to other sedimentary environments. It should be recognized that such models do not address the small-scale heterogeneity present within individual facies. However, hydrogeologic-facies models will be useful to those involved in construction of regional groundwater flow and transport models and to those involved in stochastic analysis of groundwater systems. (Author's abstract)
W89-11302

DISTRIBUTION OF DEPTH OF OVERLAND FLOW ON DESERT HILLSLOPES AND ITS IMPLICATIONS FOR MODELING SOIL EROSION.
State Univ. of New York at Buffalo. Dept. of Geography.
A. D. Abrahams, A. J. Parsons, and S. H. Luk.
Journal of Hydrology JHYDA7, Vol. 106, No. 1/2, p 177-184, March 30, 1989. 2 fig, 2 tab, 12 ref. NATO grant RG. 85/0066.

Descriptors: *Overland flow, *Slopes, *Erosion, *Model studies, *Deserts, *Soil erosion, Slopes, Detachment capacity, Water depth, Flow detachment.

Data collected during field experiments on hillslopes in southern Arizona reveal that the depth of overland flow in interrill areas can be approximated by a negative exponential distribution. Soil erosion over the greater part of most hillslopes is equal to a detachment capacity. Flow detachment in interrill area is generally modeled using a Du Boys type equation in which shear stress is calculated using the mean depth of flow. It is shown that using the mean depth rather than the distribution of depth can result in the severe underestimation of flow detachment. Insofar as the exponential density of the mean depth is characterized by a single parameter that is the reciprocal of the mean, a knowledge of the mean depth is all that is needed to specify the distribution. Utilization of the depth distribution rather than the mean depth does not require any additional information, yet it yields much more accurate estimates of flow detachment and soil erosion in interrill areas. (Author's abstract)
W89-11381

HEAVY METALS IN SEDIMENTS OF THE INNER SHELF OF THE BEAUFORT SEA, NORTHERN ARCTIC ALASKA.
For primary bibliographic entry see Field 5B.
W89-11388

EFFECTS OF STREAM ORDER AND SEASON ON MINERALIZATION OF C(14)-PHENOL IN STREAMS.
Virginia Polytechnic Inst., Blacksburg. Dept. of Biology.
For primary bibliographic entry see Field 2H.
W89-11416

STATIC EQUILIBRIUM BAYS: NEW RELATIONSHIPS.
Western Australia Univ., Nedlands. Dept. of Civil Engineering.
For primary bibliographic entry see Field 2L.
W89-11470

APPLICATIONS OF HEADLAND CONTROL.
Western Australia Univ., Nedlands. Dept. of Civil Engineering.
J. R. C. Hsu, R. Silvester, and Y. Xia.
Journal of Waterway, Port, Coastal and Ocean Engineering (ASCE) JWPED4, Vol. 115, No. 3, p 299-310, 1989. 11 fig, 35 ref.

Descriptors: *Bays, *Coastal zone management, *Geomorphology, *Beach erosion, Crenulate-shaped bays, Wave action, Wave direction, Headland control, Shore protection, Littoral drift, Check structures, Nearshore processes, Equilibrium.

Crenulate-shaped bays are ubiquitous, with a large spectrum of sizes on coasts, enclosed seas, lakes, and rivers. They exist where waves arrive persistently from an oblique direction to the general coast. They are nature's way of maintaining beaches that are in dynamic or static equilibrium. This phenomenon can be utilized to retain beaches in locations where erosion was previously encountered. This process has been termed 'headland control' which involves letting nature carry out coast protection through the effective means of an offshore bar from the beach berm. Headland control can be used to stabilize straight, bayed, or convex coasts, reducing or even stopping littoral drift where required and still bypassing sediment downcoast. The shape and orientation of headlands can be chosen to reduce the cost of structures by having beaches form in front of them. Wave climates determined at any location for headland control should account for storm wave direction as well as swell incidence. In the case of inland seas, where swell is minimal, the normal passage of cyclones should be known in order to assess predominant wave direction. (See also W89-11470) (White-Reimer-PTT)
W89-11471

MATHEMATICAL MODELING OF FLUVIAL SAND DELIVERY.
San Diego State Univ., CA. Dept. of Civil Engineering.
H. H. Chang, and D. Stow.
Journal of Waterway, Port, Coastal and Ocean Engineering (ASCE) JWPED4, Vol. 115, No. 3, p 311-326, 1989. 12 fig, 2 tab, 13 ref. NOAA National Sea Grant College Program, Dept. of Commerce Grant NA85AA-D-SG140, Project No. R/CZ-79.

Descriptors: *Fluvial sediments, *Sand, *Sediment transport, *Channel erosion, *Scour, *Model studies, *Sediment yield, *Mathematical models, Erosion, Deposition, Channel morphology, Santa Clara River, Gravel.

The delivery and yield of coarse sediment (sand and gravel) in the Santa Clara river have been studied through mathematical modeling of spatial and temporal variations of sediment characteristics for time-dependent fluvial process-response. The interactive effects on sediment yield due to sand and gravel mining, a major grade-control structure, and the dams in the drainage basin are integrated in the mathematical modeling. The simulation results are useful for identifying river reaches subject to potential erosion and deposition. They are also useful for obtaining mean annual yields at different river locations. The mean annual yield computed for the most seaward cross section is representative of the mean annual delivery to the coast. The study illustrates how scour and fill of the channel bed are accompanied by significant changes in channel width, which may contribute significantly to sediment storage. Thus, sediment yield can be quantified by an erodible-boundary mode, as opposed to an erodible-bed model. (Author's abstract)
W89-11472

OHIO RIVER BANK EROSION--TRAFFIC EFFECTS.
Louisville Univ., KY. Dept. of Civil Engineering.
D. J. Hagerty, and M. J. Hagerty.
Journal of Waterway, Port, Coastal and Ocean Engineering (ASCE) JWPED4, Vol. 115, No. 3, p 404-408, 1989. 1 fig, 1 tab, 10 ref.

Descriptors: *Wave wash, *Ohio River, *Bank erosion, *Stream banks, Navigable rivers, Barges, Traffic effects, Vegetation, Bank stabilization, Navigation, Riparian vegetation, Land classification, Correlation analysis.

In 1986, more than 700 miles of Ohio River banks were reevaluated using the same techniques employed in 1978 and in other bank-condition surveys. In the condition surveys, bare eroded banks more than 40 ft wide or more than 4 ft high were classified as 'high eroded' while bare banks 0-4 ft high or less than 40 ft wide were classed as 'low eroded.' If the bank was covered with vegetation to the water's edge, it was 'vegetated.' The banks in all the reaches of the river studied appeared less eroded in 1986 than in 1978. Traffic volume was evaluated to determine any correlation with the changes in bank conditions. The number of barges per tow increased slightly from 1978 to 1986 as a

result of increase in average horsepower of Ohio River tow-boats, and the number of tow passages increased much as did overall tonnage. No change in average speed occurred. Taken together with information obtained in previous studies, the data indicate that there was little perceptible impact of changes in in-channel traffic volume on Ohio River bank erosion/instability. This information indicates that Ohio River banks became more stable during a time interval when in-channel traffic increased rather significantly. (See also W89-11475) (White-Reimer-PTT)
W89-11474

EVALUATION OF NAVIGATION DAM EFFECTS ON RIVERBANKS.
Louisville Univ., KY. Dept. of Civil Engineering.
D. J. Hagerty, R. A. Linker, and D. A. Beatty.
Journal of Waterway, Port, Coastal and Ocean Engineering (ASCE) JWPED4, Vol. 115, No. 3, p 399-403, 1989. 2 fig, 1 tab, 9 ref.

Descriptors: *Dam effects, *Bank erosion, *Stream banks, *Navigable rivers, Ohio River, Dams, Riparian vegetation, Kentucky.

In 1981, construction of a navigation dam was completed near Smithland, KY. Surveys of the river banks provided information on bank appearance for time periods both before and after the pool was raised. The changes in the appearances of the river banks which had taken place from one inspection trip to the next were attributable to permanent inundation, to differences in river stage and to differences in seasonal vegetative cover at times of the inspections. Direct comparisons between data for inspections made before the pool raise and after the pool raise show no indication that the Smithland Dam pool raise caused any increase in erosive activity on the river banks within four years after pool raise. Riparian vegetation may provide short-term resistance to erosive action, and conditions may change to show more bare bank after 1984. Additional inspections will be made to assess long-term impacts. (See also W89-11474) (Author's abstract)
W89-11475

SEDIMENT LOADS IN THE VENTURA RIVER BASIN, VENTURA COUNTY, CALIFORNIA, 1969-81.
Geological Survey, Sacramento, CA. Water Resources Div.
B. R. Hill, and C. E. McConaughy.
Available from Books and Open File Report Section, USGS, Box 25425, Denver, CO 80225; paper copy $4.50, microfiche $4.00. USGS Water-Resources Investigations Report 88-4149, 1988. 23p, 5 fig, 7 tab, 39 ref.

Descriptors: *Sediment discharge, *Sediment transport, *Bed load, *Ventura River, *California, Suspended sediments, Ventura County.

To estimate the replenishment of beach sands by fluvial transport from the Ventura River, California sediment data collected during a 12-year period (1969-81) were used to develop relations between bedload and coarse-suspended-sediment loads and streamflow. These relations were used to calculate coarse-sediment and total-sediment loads from the Ventura River, and to assess the effects of major storms on sediment transport. Sediment data collected on an unregulated tributary over a 12-year period were used to assess effects of dam construction on sediment loads and to identify major sediment source areas in the Ventura basin. Total-sediment load from the Ventura River for the 12 years of data collection was 12,800,000 tons, of which 5,100,000 tons, or 40%, consisted of coarse material potentially available for replenishment of beach sands. Suspended-sediment transport was the dominant process supplying sediment to the coast, accounting for more than 98% of the coarse-sediment load. Higher streamflows carried proportionately more coarse-suspended sediment than low flows. Major storm events transported more than 96% of both total-sediment and course-sediment annual loads during three high-flow years. The sequence of storm events may influence storm-period sediment transport, as sediment removed rapidly during high flows is gradually replenished by hillslope processes. The sediment yield of the unregulated part of the basin was higher than that of the regulated part. Consideration of the trap efficiencies of reservoirs in the basin, however, indicates that actual yields may be highest in areas affected by impoundments. (USGS)
W89-11491

SEDIMENT BUDGET FOR A SMALL AGRICULTURAL WATERSHED.
Division of Reactor Research and Development (AEC), Washington, DC.
K. A. McGeehan.
Water Pollution Control Association of Pennsylvania Magazine, Vol. 22, No. 3, p 14-19, May-June 1989. 9 fig, 7 ref.

Descriptors: *Sediment yield, *Agricultural watersheds, *Bank erosion, *Susquehanna River Basin, *Gully erosion, Chesapeake Bay, Banks, Gullies, Overland flow, Erosion, Rill erosion, Storms.

The sediment budget was calculated for streams of the lower Susquehanna basin, an agricultural watershed. Net aggradation or degradation and changes in position of the stream bank were calculated and discharge and sediment yield monitored for five stations. Two different methods, the individual storm budget and the annual sediment budget, produced similar conclusions. In both cases, bank erosion was found to contribute more than 50% of the total sediment yield of the stream. The source of the rest of the sediment is primarily rill and gully erosion of saturated areas near the stream channel. Bank erosion rates are high throughout the watershed, but highest in the lower reaches of the watershed where the banks are highest. Gully erosion is highest in the flatter parts of the upper section of the watershed where there are many saturated areas near the stream. The stream channel is currently eroding more sediment from stream bank sources than it did in the time period prior to agricultural development. Sediment from agricultural erosion was deposited in topographic lows on the hillslopes, particularly in the upper part of the watershed, resulting in a flattening of the landscape and the development of saturated areas during storms. (Doria-PTT)
W89-11504

SOLUTIONS TO PROBLEMS IN ENUMERATING SEDIMENT BACTERIA BY DIRECT COUNTS.
McGill Univ., Montreal (Quebec). Dept. of Biology.
For primary bibliographic entry see Field 5A.
W89-11509

DIATOM ASSEMBLAGES ASSOCIATED WITH SEDIMENT IN OGRYUDEUNG SAND BAR OF THE NAGDONG RIVER ESTUARY, KOREA.
Tohoku Univ., Sendai (Japan). Biological Inst.
For primary bibliographic entry see Field 2L.
W89-11586

ACCOUNT OF THE HISTORY, FLORA AND VEGETATION OF NATURE RESERVE 'HET MOLENVEN', PROVINCE OF OVERIJSSEL, THE NETHERLANDS,
Amsterdam Univ. (Netherlands). Hugo de Vries Lab.
For primary bibliographic entry see Field 2I.
W89-11604

FORMATION PROCESSES OF LACUSTRINE DELTA--AN EXAMPLE FROM ECHI RIVER DELTA, LAKE BIWA--1. RECENT SEDIMENTARY ENVIRONMENTS.
Geological Survey of Japan, Tsukuba. Environmental Geology Dept.
Y. Miyata, T. Yamamura, Y. Kodato, and S. Tokuhashi.
Journal of the Geological Society of Japan CHTZA5, Vol. 95, No. 3, p 209-225, March 1989. 16 fig, 39 ref. English summary.

Descriptors: *Lakes, *Fluvial sediments, *Geomorphology, *Sedimentation, *Deltas, *Sediment transport, *Japan, *River mouth, Sand, Mud flats, Storms, Waves, Floods, Sandbars, Density currents.

The Echi River which discharges into Lake Biwa has built a lacustrine cuspate delta with a subaerial area of about 2 sq km. The foreset of the subaqueous part of the delta is 13 m high and inclines at 1 to 5 degrees. The nearshore zone of the delta (shallower than 3 m) is about 400 m wide, and repeated longshore bars are formed on the north coast. The foreset slope of the delta is covered with fair weather mud with storm sand intercalations, which become finer downslope. Offshore muddy sediments are ill-bedded and composed mainly of terrigenous mud and microorganisms (mostly diatoms). Floods and wave actions play major roles on the deltaic sedimentation. Among sediments supplied by floods, sandy fractions settle down near the mouth, while muddy fractions are kept in suspension and widely dispersed. Sandy sediments of the river mouth are transported laterally along the coast forming longshore bars, and are frequently put into suspension by monsoonal wind waves. Storm waves and surges are more effective in carrying the nearshore sediment to the delta slope and offshore. Density or turbidity currents are also expected, but they have not been confirmed yet. On the slope of 15 to 50 m depth, where the sediment accumulation is limited, characteristic large mud ripples are formed parallel to the depth contours. On this slope, some kind of deep water agitation is also expected. (Author's abstract)
W89-11614

LAG-TIME ROUTING OF SUSPENDED SEDIMENT CONCENTRATIONS DURING UNSTEADY FLOW.
Maryland Univ., College Park. Dept. of Geography.
W. A. Marcus.
Geological Society of America Bulletin BUGMAF, Vol. 101, No. 5, p 644-651, May 1989. 8 fig, 7 tab, 18 ref.

Descriptors: *Flood routing, *Sediment concentration, *Unsteady flow, *Routing, *Sediment transport, *Flood waves, *Stream discharge, *Suspended sediments, Mathematical models, Storms, Bighorn River, Seasonal variation.

The different velocities of flood waves and stream flow can be a major control on the relation of stream discharge to suspended sediment concentrations. Flood waves move downstream faster than the flow velocity, thus leaving the original floodwaters and their entrained sediments lagging increasingly farther behind with increasing distance downstream. This process can be modeled by routing the changes in discharge at the flood-wave celerity, while routing the sediments at the flow velocity. Testing of this model using data previously collected for the Bighorn River, Wyoming and Montana, indicates that differences in flood-wave and flow velocity can explain a large portion of the downstream variations in the relation of discharge to concentration through time. The routing model results suggest that one explanation of seasonal and storm-period variations in at-a-station sediment rating curves may be seasonal changes in the distance to sediment sources. Possible reasons for variations in sediment concentration not accounted for by the model include: (1) settling of suspended sediments and/or suspension of bed-material sediments; (2) unmonitored tributary inputs; and (3) dispersion and diffusion. (Author's abstract)
W89-11636

BUFFER EFFECT OF A WIDE RIVERBED SECTION ON SEDIMENT DISCHARGE.
Hokkaido Univ., Sapporo (Japan). Dept. of Forestry.
F. Nakamura.
Journal of the Faculty of Agriculture Hokkaido University JFAGAI, Vol. 64, No. 1, p 56-69, March 1989. 10 fig, 11 ref. Ministry of Education, Science and Culture Grant-in-Aid 61760117,

62760109.

Descriptors: *Sediment discharge, *Sediment transport, *Streambeds, *River beds, Channel morphology, Sedimentation, Bed load, Channel storage, Flood peak, Simulation, Sediment concentration, Bedrock.

Sediment storages in a river channel are typically observed at the foot of hillside slopes and where the river morphology changes, such as a sinuous river section, a wide section of river, and a junction with tributaries. A wide section of sediment storage, and its effects on sediment discharge, was studied. The actual channel morphology observed in the wide sections were complex due to frequent channel migrations. The maximum age, total amount, and residence time of flood-pain deposits were evaluated for the wide and narrow sections of the Usubetsu River. This comparison indicated that the wide section has stored a large amount of sediment as flood-plain deposits, which result in a long residence time of sediment. Experiments and numerical simulations were carried out to estimate the effects of a wide section on sediment discharge in two cases. The first case assumed a period of days that contained one peak of discharge, while the second case assumed a period as long as a hundred years, during which several tens of floods had occurred. An important characteristic of mountain rivers is that there is a difference between the volumes of sediment production and potential transport. In experiments and simulations, therefore, the influx volume was changed according to the conditions of sediment accumulation in the upper production reach. The experiments demonstrated that the wide section served to store sediment when a large volume of bed load was transported, and served to flush it out when transport rate had decreased. The results of simulations, comparing the effects of the wide and uniform sections, showed that the wide section functions as a buffer zone, reducing the variances of sediment discharge and lowering the maximum discharge rate. It was clarified that this buffer effect was determined by the upstream area of reference points created by bedrocks. (Author's abstract)
W89-11661

RESPONSES OF THE SEDIMENT SYSTEM OF A REGULATED RIVER TO A SCOUR VALVE RELEASE: LLYN CLYWEDOG, MID-WALES, U.K.
Institute of Hydrology, Powys (Wales). Fluvial Geomorphology Unit.
G. J. L. Leeks, and M. D. Newson.
Regulated Rivers Research and Management RRRMEP, Vol. 3, No. 1-4, p 93-106, Jan-Apr 1989. 7 fig, 2 tab, 22 ref.

Descriptors: *Sediment discharge, *Wales, *Erosion control, *Regulated flow, *Reservoir releases, *Suspended sediments, Bed load, Bank erosion, Scour valves, Sediment transport, Flood flow, Channel morphology.

In March 1985, engineering tests of scour valves at the base of the Llyn Clywedog regulating reservoir resulted in a controlled peak release discharge of 53 cu m/s into regulated reaches of the upper Severn. To exploit this unusual opportunity, simple monitoring systems were set up within the first 50 km downstream to assess the morphological effects on bed and banks and the movement of bed and suspended sediments. The interpretation of suspended sediment transport patterns became the major analytical task following the release, since bedload and morphological impacts were minimal. In comparison with natural floods, the scour valve release exhibited suspended sediment concentrations usually associated with a five-year event, but with a complex time and space pattern resulting from the release strategy. This was due to the complex ramping up of the water discharge and the supply of sediments from the bank collapse upstream, in addition to material derived directly via the scour valves, from the reservoir. The bank collapse presented no structural danger; however, it did represent a major contribution to stream sediment load. Therefore, in streams which are not as resistant to erosion as the rocky channel of the Clywedog, it is desirable to consider the use of revetment works to protect the toe-slopes at sensitive sites. Since scour releases can be planned with greater flexibility than major water resource releases, indications are that they should be made 'on the back of' natural high flows although sensitive sites may require protection. (Author's abstract)
W89-11700

ASSESSMENT OF BED LOAD SEDIMENT TRANSPORT FORMULAE FOR GRAVEL BED RIVERS,
Oxford Univ. (England). Geography School.
B. Gomez, and M. Church.
Water Resources Research WRERAO, Vol. 25, No. 6, p 1161-1186, June 1989. 7 fig, 8 tab, 107 ref.

Descriptors: *Bed load, *Bed-load discharge, *Sediment transport, *Mathematical equations, Comparison studies, Performance evaluation, Equilibrium sediment transport, Stream power, Hydraulic data.

The performance was tested of 12 bedload sediment transport formulae developed for use in gravel bed channels. The formulae are applied to in the manner intended by their originators. To this end, the test data are restricted to those obtained in approximately steady flow when the material in motion was similar to that present on the bed; that is, transport was not size selective. This represents the nearest approach to 'equilibrium sediment transport' that can be realized with available data. Four sets of river data and three sets of flume data were chosen for the test, covering a range of eight orders of magnitude in unit bed load transport rate. The test data were not used in the development of the formulae. The analysis separates mean bias and local bias. No formula performs consistently well. Limitations of the test data, the constraints imposed by an operationally realistic test, and reasons based on the physics of the transport phenomena all may account for this. To estimate the magnitude of transport with limited hydraulic information, stream power equations should be used because they provide the most straightforward scale correlation of the phenomenon. In particular, the approach of Bagnold deserves further study. When local hydraulic information is available, a formula should be selected that is sensitive to bed state or grain size distribution and, in this context, the formulae of Einstein, Parker, and Ackers-White Day bear continued examination. (Author's abstract)
W89-11759

SEDIMENT TRANSPORT AND RESULTING DEPOSITION IN SPAWNING GRAVELS, NORTH COASTAL CALIFORNIA.
Pacific Southwest Forest and Range Experiment Station, Arcata, CA.
T. E. Lisle.
Water Resources Research WRERAO, Vol. 25, No. 6, p 1303-1319, June 1989. 14 fig, 4 tab, 50 ref.

Descriptors: *California, *Streambeds, *Sedimentation, *Aquatic habitats, Fish eggs, Spawning, Storm runoff, Gravel, Bed-load discharge, Interstice, Spatial variation, Temporal variation, Scour.

Incubating salmonid eggs in streambeds often are threatened by deposition of fine sediment within the gravel. To relate sedimentation of spawning gravel beds to sediment transport, infiltration of fine sediment (< 2 mm in diameter) into clean gravel beds, bed material distributions, scour-fill depths, and sediment transport during 10 storm flow events were measured in three streams in north coastal California. Although suspended sediment comprised most (75-94%) of the clastic load during storm flows, bed load material (0.25-2 mm) accounted for most (70-80%) of the fine sediment accumulated in experimental gravel implanted in the streambeds. Sand trapped in the interstices of the top several centimeters formed a seal that impeded deeper deposition of very fine sand and finer material. The seal was responsible, at least in part, for a decrease in the rate of fine-sediment accumulation with increasing cumulative bed load transport. Areas of the streambeds commonly scoured or filled 0.1 m or more during storm flows, and thus scour and fill commonly created a sandy layer at least as thick as the seal formed by sediment infiltration. Scour could erode eggs laid in the bed and expose deeper levels of the bed to infiltration by fine sediment, but at the same time could allow fine sediment to be winnowed away. Great temporal and spatial variation in sedimentation in these streams suggests that individual storms of moderate size pose a threat to eggs in many, but not all, areas selected by fish for spawning. (Author's abstract)
W89-11771

NEW METHOD FOR ESTIMATING FUTURE RESERVOIR STORAGE CAPACITIES,
Illinois State Water Survey Div., Champaign.
K. P. Singh, and A. Durgunoglu.
Water Resources Bulletin WARBAQ, Vol. 25, No. 2, p 263-274, April 1989. 3 fig, 4 tab, 7 ref.

Descriptors: *Reservoir silting, *Reservoir storage, *Water supply, *Water management, *Sedimentation, Model studies, Sediment transport, Reservoirs, Dam design.

A new method has been developed for estimating future reservoir storage capacities, allowing for sediment deposition and compaction. Reservoir sedimentation surveys for 117 reservoirs, conducted by the Illinois State Water Survey over the past 60 years, were used to determine regional constants (K) to represent the severity of sediment deposition in the reservoirs. More than half of the 82 water supply reservoirs investigated had records of reservoir sedimentation surveys, and their K values were calculated by using remaining non-surveyed water supply reservoirs were estimated from the regional distribution of the K values. Other important factors considered in the estimation of future reservoir storage capacities are the trap efficiency of the reservoirs and the variation of density of sediment deposits due to compaction. The model can also be used for analyzing the economics of alternatives sites and of design features that can be incorporated in dams for reducing reservoir sedimentation. (Author's abstract)
W89-11787

COMPARISON OF METHODS OF ESTIMATING MEAN WATERSHED SLOPE,
Stephen F. Austin State Univ., Nacogdoches, TX. School of Forestry.
For primary bibliographic entry see Field 2E.
W89-11794

DIAGENESIS OF ORGANIC MATTER IN GEORGIA SALT MARSHES.
Carnegie Institution of Washington, DC. Geophysical Lab.
For primary bibliographic entry see Field 2L.
W89-11809

NEWPORT NEWS CHANNEL DEEPENING STUDY, VIRGINIA: NUMERICAL MODEL INVESTIGATION.
Army Engineer Waterways Experiment Station, Vicksburg, MS. Hydraulics Lab.
For primary bibliographic entry see Field 8B.
W89-11904

ESTIMATE OF THE OCCURRENCE AND DISTRIBUTION OF TOXICANTS IN STREAMBED SEDIMENTS OF THE SUSQUEHANNA RIVER SYSTEM.
Susquehanna River Basin Commission, Harrisburg, PA.
For primary bibliographic entry see Field 5B.
W89-12101

INLET HYDRAULICS AT GREEN HARBOR, MARSHFIELD, MASSACHUSETTS.
Coastal Engineering Research Center, Vicksburg, MS.
For primary bibliographic entry see Field 8B.
W89-12106

FLUSHING AND SCOURING FLOWS FOR HABITAT MAINTENANCE IN REGULATED STREAMS.
Environmental Protection Agency, Washington, DC. Office of Water Regulations and Standards.
For primary bibliographic entry see Field 4A.
W89-12109

GLACIATED COASTS.
Boston Univ., MA. Dept. of Geology.
Academic Press, Inc., New York. 1987. 364p. Edited by Duncan M. Fitzgerald and Peter S. Rosen.

Descriptors: *Coasts, *Geomorphology, *Fjords, *Glaciation, Coastal waters, Geography, Glaciers, Ice, Rocks, Sediment characteristics, Sediments, Sea level, Tectonics, Estuaries, Beaches, Glacial sediments, Submergence.

This book results from the recognition that while the morphology and processes of shorelines south of the glacial limit in North America have been rigorously investigated and regionally compared, glaciated northern shorelines have not received a similar amount of regional analysis. Diversity is the common theme to the glaciated coasts. North the glacial limit, shorelines are most often primary in form and in various stages of modification by marine agents. Shoreline reaches, or distances of similar processes, become shorter as terrestrial processes control shore outlines. This more complex shoreline form results in a large percentage of the coast consisting of various types of embayments, such as estuaries and fjords. The prevalence of embayments increases the range of wave energy along the coast, which creates further small-scale variation in forms. Extreme differences in isostatic and tectonic setting produce large variations in relative sea level, both areally and in the Holocene history of shorelines. Both emergent and submergent coasts commonly occur. The 13 chapters in this volume cover a range of geologic and geographic coastal settings and are roughly arranged in a north to south order. At least four chapters are involved with characterizing shorelines associated with embayments. Two chapters describe baymouth barriers that enclose embayments. With the exception of areas consisting of reworked outwash deposits, most chapters deal with beaches having coarse or mixed sediment populations. Compared with sandy beaches, coarse sediment beaches have received little attention in the past. The remaining two chapters examine the southeastern coast of Alaska, showing the influence of active tectonism on a mountainous shoreline, and present a unique glaciated coastal environment. (See W89-12119 thru W89-12125) (Lantz-PTT)
W89-12118

FJORD SEDIMENTATION IN NORTHERN BRITISH COLUMBIA.
McMaster Univ., Hamilton (Ontario). Dept. of Geography.
S. B. McCann, and R. A. Kostashuk.
IN: Glaciated Coasts. Academic Press, Inc, New York. 1987. p 33-49, 7 fig, 2 tab, 23 ref.

Descriptors: *Sedimentation, *Fjords, *British Columbia, Fluvial sediments, Seismology, Glaciation, Geomorphology, Deltas, Geologic history, Glacial drift, Suspended sediments.

The character of fjord sediment in northern British Columbia is determined by glacial and glacial-marine events during the last glaciation, in particular the retreat phase, and by a variety of Holocene processes, of which the most important are related to fluvial inputs of sediment and delta progradation. Analysis of seismic profiles from Burke Channel-North Bentinck Arm, a 120-km-long fjord penetrating the Coast Mountains, identified two seismic sequences. The lower, late Pleistocene, sequence contains tills, glacial-marine deposits, and subaqueous moraines. For the most part it is overlain by a thinner, Holocene sequence, deposited from suspension from the plume of Bella Coola River, which enters the head of the fjord, and by turbidity currents that originate on the Bella Coola delta front. (See also W89-12118) (Author's abstract)
W89-12120

EVOLUTIONARY MODEL FOR TRANSGRESSIVE SEDIMENTATION ON THE EASTERN SHORE OF NOVA SCOTIA,
Dalhousie Univ., Halifax (Nova Scotia). Centre for Marine Geology.
R. Boyd, A. J. Bowen, and R. K. Hall.
IN: Glaciated Coasts. Academic Press, Inc, New York. 1987. p 87-114, 13 fig, 34 ref. Canadian Government grants NSERC A8425 and EMR 202.

Descriptors: *Coasts, *Glacial sediments, *Sedimentation, *Nova Scotia, *Model studies, Erosion, Submergence, Tidal flats, Deltas, Coastal waters, Sediment transport.

The Eastern Shore of Nova Scotia consists of a series of linear embayments and intervening headlands. This region experiences mesotidal conditions and a relatively high-energy east-coast wave environment. Sea-level transgression is driven by a relative sea-level rise of 35-40 cm/100 yr. An evolutionary model has been developed to account for the wide range of variability present in coastal compartments and shoreline processes. Deposition during transgression is controlled by valley and ridge systems aligned SE to NW. Sediments are derived from eroding till cliffs and drumlins in exposed headland locations. Submergence of the valleys provides the only major site for deposition. Sand and gravel are transported alongshore from headland sources to infill the submerged valley mouths with barrier systems. Tidal inlets exchange the large tidal prisms that form after barrier progradation. As sediment supply diminishes from till and preexisting barriers, relative sea-level rise becomes the dominant factor and a period of barrier retreat and destruction begins. Eolian, overwash and tidal inlet processes remove sediment from the barrier and deposit it in flood tidal delta, washover, and estuarine environments. Later, landward translation of the shoreline causes these sediments to be exhumed on the barrier retreating shoreface, reworked onshore, and accumulated in new barrier locations. Evolution of the Eastern Shore can be summarized as alternate periods of transgression and regression within an overall framework of coastal submergence. (See also W89-12118) (Author's abstract)
W89-12121

HOLOCENE EVOLUTION OF THE SOUTH-CENTRAL COAST OF ICELAND.
Louisiana State Univ., Baton Rouge. Dept. of Geology and Geophysics.
D. Nummedal, A. C. Hine, and J. C. Boothroyd.
IN: Glaciated Coasts. Academic Press, Inc, New York. 1987. p 115-150, 22 fig, 2 tab, 43 ref. Naval Ordnance Laboratory Contract N6092-73-C-0258.

Descriptors: *Geologic history, *Coasts, *Geomorphology, *Iceland, *Sedimentation, *Coastal waters, *Glacial sediments, Glaciation, Cyclones, Erosion, Sediment transport, Outwash, Volcanoes, Wave action, Vegetation effects.

The south-central coast of Iceland consists of broad alluvial outwash plains, 'sandurs.' Landward, the sandurs are flanked by piedmont glaciers and high basalt cliffs; seaward they terminate in extensive barrier spits. The sandurs receive most of their sediment during glacier bursts caused by subglacial volcanic activity or the failure of marginal ice dams retaining meltwater. Large volcanogenic bursts carry discharges as high as 100,000 cu m/sec. The wave energy along the Atlantic shore of these sandurs is among the highest in the world. Extratopical cyclones passing south of Iceland in the winter season reach their peak energy when the associated winds blow onto the south Icelandic coast from the southwest. Consequently, longshore sediment transport is generally directed to the west along the east-west shorelines. Convergence zones, characterized by rapid coastal progradation, are found within bights facing the southeast. The combination of frequent glacier bursts, a nearly vegetation-free coastal zone, and extreme coastal storm dominance has produced in south Iceland a suite of sedimentary environments with few analogs elsewhere. (See also W89-12118) (Author's abstract)
W89-12122

INVENTORY OF COASTAL ENVIRONMENTS AND CLASSIFICATION OF MAINE'S GLACIATED SHORELINE,
Maine Geological Survey, Augusta.
J. T. Kelley.
IN: Glaciated Coasts. Academic Press, Inc, New York. 1987. p 151-176, 12 fig, 2 tab, 32 ref.

Descriptors: *Coasts, *Maine, *Glaciation, *Geomorphology, *Glacial sediments, *Sedimentation, Classification, Erosion, History, Coastal waters, Marshes, Mud flats, Estuaries, Bedrock.

A detailed examination of the variation in physiographic parameters and geological environments along the glaciated coast of Maine indicates that coastal variability is primarily controlled by regional changes in bedrock composition and structure. Quaternary sediment abundance and composition, and differential rates of relative sea level rise. The Q-mode factor analyses suggest that three coastal-zone cross sections of 'end member' composition--mudflat, marsh, and ledge profiles--are the principal elements comprising an ideal Maine estuary. This technique reduces a matrix of n variables by m observations to one of N by F (factors) with a minimum loss of information. Regional variation in the relative importance of the three profiles results in a four-compartment classification of Maine's glaciated, estuarine coastline: (1) Southwest - a section of low-relief estuarine embayments bounded by topographically high bedrock capes; (2) South-central - a compartment of deep, narrow, elongate estuaries that are parallel to the strike of the adjacent bedrock peninsulas; (3) North-central - a compartment of generally broad, deep estuaries possessing an abundance of rounded, granitic islands; and (4) Northeast - a compartment with a very high-relief, outer cliffed component and an irregular, high-tidal-range protected estuary. (See also W89-12118) (Lantz-PTT)
W89-12123

QUATERNARY STRATIGRAPHY OF REPRESENTATIVE MAINE ESTUARIES: INITIAL EXAMINATION BY HIGH-RESOLUTION SEISMIC REFLECTION PROFILING.
Maine Univ. at Orono. Dept. of Geological Sciences.
D. F. Belknap, J. T. Kelley, and R. C. Shipp.
IN: Glaciated Coasts. Academic Press, Inc, New York. 1987. p 177-207. 10 fig, 87 ref.

Descriptors: *Geologic history, *Geomorphology, *Maine, *Stratigraphy, *Estuaries, *Seismology, *Glaciation, Glacial drift, Glacial sediments, Sea level.

High-resolution seismic profiling is used to define submerged late Quaternary stratigraphic units on the coast of Maine. Wisconsinan glaciation sculpted bedrock valleys and later deposited till, glaciomarine sediments, and glaciofluvial sediments. The bedrock structure and variable sediment thicknesses and types produce a series of four different geomorphic zones along the coast. In order to examine differences in bedrock geology, glacial history, geomorphology, and Holocene coastal processes as controls on Quaternary evolution of the Maine coast, three representative estuaries were chosen for investigation from the two central zones. A major control in this evolution is sea-level change, the result of glacioisostatic and glacioeustatic fluctuations. Relative sea level rose to at least 130 m above present 12,000 yr B.P. and fell to at least 60 m below present between 10,000 and 8,000 yr B.P., causing rapid coastal transgressions and regressions. An idealized stratigraphic section produced by these factors starts on bedrock, beginning with till overlain by glaciomarine mud and coarse deltaic sediment, further overlain by glaciofluvial outwash. This sequence is cut by an unconformity produced during the regression and subsequent transgression. Overlying this unconformity are Holocene sand, mud, and peat deposits in estuarine and inner shelf facies. Major factors in estuarine evolution are bedrock structure, direction of glacial scour, and nature and thickness of the glacial

deposits. Secondary factors include littoral and terrestrial erosive processes during regression and subsequent transgression, and Holocene coastal processes of tides and waves. Maine estuaries show the effects of glaciation as a pervasive control. They differ from coastal plain estuaries of the U.S. Atlantic coast in the degree of structural control and types of sediment available. They are similar in many respects to Atlantic Canadian estuaries, except for their more extreme relative sea level excursions since glaciation. (See also W89-12118) (Author's abstract)
W89-12124

DEVELOPMENT OF THE NORTHWESTERN BUZZARDS BAY SHORELINE, MASSACHUSETTS.
Boston Univ., MA. Dept. of Geology.
D. M. FitzGerald, C. T. Baldwin, N. A. Ibrahim, and D. R. Sands.
IN: Glaciated Coasts. Academic Press, Inc, New York. 1987. p 327-257, 18 fig, 38 ref.

Descriptors: *Sedimentation, *Geomorphology, *Coastal waters, *Glaciation, *Erosion, *Massachusetts, Topography, Sandspits, Buzzards Bay, Glacial sediments, Estuaries, Tidal flats, Inlets.

The western Buzzards Bay coast consists of a series of headlands and intervening drowned valleys which are fronted by various types of barriers. The general topography of the region is a product of late Tertiary fluvial erosion and repeated Pleistocene glaciations. The depth and width of the valleys coupled with the availability of sediment have dictated the morphological genesis of individual embayments. Where valleys are narrow and/or shallow, coastal ponds fronted by barrier beaches have formed. Larger and deeper valleys are protected by spit systems and maintain tidal inlets due to greater bay tidal prisms. Differences in the dynamic histories of the two largest embayments in this area (Slocum River and Westport River estuaries) are explained in terms of availability and proximity of glaciogenic and other sediment sources as well as contrasting exposures to wave processes. (See also W89-12118) (Author's abstract)
W89-12125

EVALUATIONS OF COLLAPSE SUSCEPTIBILITY IN ALLUVIAL FAN DEPOSITS-TOWAOC, CANAL, REACH 2, TOWAOC, COLORADO.
Bureau of Reclamation, Denver, CO. Div. of Research and Lab. Services.
R. W. Luehring.
Available from the National Technical Information Service, Springfield, VA 22161 as PB89-152029, Price codes: A20 in paper copy, A01 in microfiche. Masters Thesis, May 1988. 430p, 94 fig, 20 tab, 87 ref, 9 append.

Descriptors: *Subsidence, *Colorado, *Soil classification, *Alluvial fans, *Stress, *Canals, *Soil transport, Towaoc Canal, Sedimentation, Erosion, Alluvial deposits, Sediment load, Wetting.

Field and laboratory geotechnical investigations were undertaken to evaluate collapse susceptibility upon wetting of soils traversed by Towaoc Canal. Investigations were prompted because of documented subsidence up to 4 ft upon wetting of a 100-acre plot. Portions of the canal intersect alluvial fan deposits, up to 80 ft thick, that overlie complexly layered Quaternary sediments. Principal deposition processes of alluvial fan deposits include sheetflow and sheet erosion conditions. Collapsible soils were formed in the interfan areas. Undisturbed samples from four drill holes were obtained for use in the laboratory investigation. Using a double oedometer technique, data from 57 oedometer tests were analyzed to quantify collapse. Soils were also classified according to classical qualitative analyses. Results indicate collapse susceptibility and collapse are related to an in situ stress state. The relationship of normalized strain and pressure at wetting was investigated for high and medium collapse-susceptible soils. This relationship appears to yield characteristic curves that may provide a quantitative collapse evaluation technique. (Author's abstract)
W89-12138

2K. Chemical Processes

KINETICS OF ACETATE AND METHANOL CONVERSION INTO METHANE IN EUTROPHIC SEDIMENTS AND ITS APPLICATION IN ANAEROBIC SYSTEMS.
Max-Planck-Inst. fuer Limnologie zu Ploen (Germany, F.R.). Abt. Mikrobenoekologie.
For primary bibliographic entry see Field 2H.
W89-11078

DISSIMILATIVE IRON REDUCTION BY THE MARINE EUBACTERIUM ALTEROMONAS PUTREFACIENS STRAIN 200.
California Inst. of Tech., Pasadena. W.M. Keck Engineering Lab. of Hydraulics and Water Resources.
T. J. DiChristina, R. G. Arnold, M. E. Lidstrom, and M. R. Hoffmann.
Water Science and Technology WSTED4, Vol. 20, No. 11/12, p 69-79, 1988. 2 fig, 1 tab, 37 ref.

Descriptors: *Iron bacteria, *Marine bacteria, *Geochemistry, *Iron, *Biodegradation, Heavy metals, Microenvironment, Sediments, Chemical reactions, Physico-chemical properties, Bacteria, Mutation, Cloning.

The ability of microorganisms to mediate the transformation of iron coupled with the participation of iron as a reactive redox species in natural waters and sediments has prompted recent speculation that such bacteria play an important role in such activities as global iron cycling and biologically induced mineral formation. Microaerophilic soil bacteria dominate the list of microorganisms capable of iron reduction. However, screening experiments have shown that the marine eubacterium Alteromonas putrefaciens strain 200 is one of the most efficient iron reducers yet isolated. Respiratory inhibitor studies have suggested that a branched respiratory chain and two ferri-reductases (one constitutive and one induced by growth under microaerophilic conditions (2 microns O2) are involved in iron reduction. further complementary biochemical and genetic studies have concentrated on characterizing the components of the induced iron reduction system. Ethyl methane sulfonate (EMS) has been used to develop mutagenesis procedures for A. putrefaciens 200; under optimal conditions, the frequency of total auxotrophy for EMS-treated cultures is approximately 0.4%. Tests for specific auxotrophic requirements have indicated the presence of a complex distribution of loci required for biosynthetic pathways. Mutants in both high-rate and low-rate ferri-reductase activity have been identified via a newly developed technique for screening EMS-treated A. putrefaciens 200 cultures. Ferri-reductase-deficient mutants generated by these techniques have been shown to contain reduced cytrochrome content. Preliminary results indicate that the broad host range cloning vector pVK100 (Inc P) can be mobilized into A. putrefaciens 200. (Author's abstract)
W89-11079

BINDING OF METAL IONS BY EXTRACELLULAR POLYMERS OF BIOFILM BACTERIA.
California State Univ., Long Beach. Dept. of Microbiology.
G. G. Geesey, L. Jang, J. G. Jolley, M. R. Hankings, and T. Iwaoka.
Water Science and Technology WSTED4, Vol. 20, No. 11/12, p 161-165, 1988. 5 fig, 1 tab, 3 ref. NSF Grants ECE-8521693 and ECE-8701462.

Descriptors: *Biofilms, *Cations, *Water chemistry, *Corrosion, *Bacteria, *Biochemistry, *Copper, *Substrates, *Polymers, Ions, Chemical properties, Microorganisms, Corrosion, Heavy metals.

Exopolymers that anchor sessile bacteria to metallic surfaces exhibit the capacity to bind copper ions with high affinity. Ionized carboxyl groups on the polymers appear to participate in cupric ion binding. Formation of complexes between the polymers and cupric ions results in the release of protons from the polymer molecule. Some exopolysaccharides exhibit a high affinity for certain metal ions. The tendency of acidic polysaccharides to bind metal ions may, therefore, influence the stability of ground state metal atoms that are in contact with these microbial products. A study was conducted to implicate acidic polysaccharides in the corrosion of copper surfaces. Attenuated total reflectance Fourier transform infrared spectroscopy showed that polymers composed of acidic polysaccharides promote ionization and deterioration of metallic copper surfaces. X-ray photoelectron spectroscopy studies revealed that the ionic state of the surface-derived copper varied depending on the type of acidic polysaccharide that was in contact with the surface. The results suggest that exopolymers elaborated by adherent bacteria can enhance corrosion of the surfaces with which they are associated. (Friedmann-PTT)
W89-11091

GEOCHEMICAL PARTITIONING OF PB, ZN, CU, FE, AND MN ACROSS THE SEDIMENT-WATER INTERFACE IN LARGE LAKES.
Michigan State Univ., East Lansing. Dept. of Geological Sciences.
J. D. McKee, T. P. Wilson, D. T. Long, and R. M. Owen.
Journal of Great Lakes Research JGLRDE, Vol. 15, No. 1, p 46-58, 1989. 8 fig, 3 tab, NOAA Office of Sea Grant, grant NA86AA-D-SG043, project R/ES-2, EPA contract CR813535-01-1.

Descriptors: *Limnology, *Lake sediments, *Bottom sediments, *Sediment-water interfaces, *Heavy metals, *Diagenesis, *Geochemistry, Lead, Zinc, Copper, Iron, Manganese, Submarines, Lake Superior, Great Lakes.

The early diagenetic remobilization of Mn, Fe, Zn, Cu, and Pb was evaluated by studying the geochemical partitioning of the metals among hydromorphic phases (as operationally defined by sequential-chemical extractions) in interfacial sediment (fluff) and in the sediment column, at a site in the Caribou sub-basin, Lake Superior. The fluff was collected with a vacuum/filtration system developed for the submersible Johnson Sea-Link II and the sediment column by gravity coring. The results show that : (1) Pb, Cu, and Zn exhibit sediment profiles in which their concentrations decrease with depth for total metal and some of the hydromorphic phases; (2) Mn and Fe profiles are the result of early diagenesis; (3) each of the metals is uniquely partitioned among the phases and the partitioning changes from the fluff to the sediment column and with depth; and (4) the concentrations of Zn, Cu, and Pb in the fluff are higher than those in the sediment columns and, in some instances, appear to be an exponential extrapolation of the latter. The results are interpreted to indicate that the metals are remobilized during early diagenesis and that the fluff may be chemically unique compared to the sediment column, perhaps being similar to interfacial sediments identified in deep marine environments. It appears that studying the metal concentrations in the individual hydromorphic phases of the sediment is more useful in identifying diagenetic processes than is examination of either total hydromorphic or total metal concentrations of the sediment. (Author's abstract)
W89-11185

GEOCHEMISTRY OF RARE EARTH ELEMENTS IN BENTHIC LAYER PARTICULATE MATTER AND SEDIMENTS OF LAKE SUPERIOR.
Michigan State Univ., East Lansing. Dept. of Geological Sciences.
A. M. Olivarez, R. M. Owen, and D. T. Long.
Journal of Great Lakes Research JGLRDE, Vol. 15, No. 1, p 59-67, 1989. 5 fig, 3 tab, 27 ref. NOAA Office of Sea Grant, grant NA86AA-D-SG043, project R/ES-2.

Descriptors: *Lake sediments, *Suspended sediments, *Bottom sediments, *Rare earth elements, *Diagenesis, *Geochemistry, Lanthanum, Cerium,

Neodymium, Samarium, Europium, Terbium, Ytterbium, Lutecium, Silica, Organic carbon, Diatoms, Submarines, Lake Superior, Great Lakes.

Samples of suspended particulate matter from the nepheloid layer and the benthic sediment layer (fluff zone), as well as core samples of the underlying sediment column, were collected from two locations in Lake Superior during manned submersible dives. All samples were analyzed for 8 rare earth elements (REE), biogenic silica, and organic carbon. The REE patterns indicate lithogenous material is a dominant component in all samples but that significant amounts of REE's derived from the water column are also present. Biogenous sources (diatom shells) contribute negligibly to the REE geochemistry of these samples. Statistical analyses of the geochemical data suggest that the mechanism by which REE's are removed from the water column involve scavenging by particulate phases of Fe. The Precambrian banded iron formations around Lake Superior represent an abundant source of dissolved and particulate Fe to the lake. Absolute concentrations of both REE's and Fe are greater in the fluff layer than in the nepheloid layer; however, the nepheloid layer contains 24-57% more REE's on a per unit Fe basis. This difference may be due to longer exposure of nepheloid particulate matter to lake waters than fluff, diminished scavenging efficiency higher Fe levels, and/or to the fact that particulate matter in the fluff layer is derived from surficial sediments which have lost some REE's during early diagenesis. A comparison of the Ce-anomalies of the suspended layers with the sediments indicates the sediments have undergone some degree of early diagenesis. (Author's abstract)
W89-11186

RELATIVE VALUES OF OXYGEN, NITRATE, AND SULFATE TO TERMINAL MICROBIAL PROCESSES IN THE SEDIMENTS OF LAKE SUPERIOR.
Michigan State Univ., Hickory Corners. W.K. Kellogg Biological Station.
For primary bibliographic entry see Field 2H.
W89-11191

METHANE OXIDATION IN LAKE SUPERIOR SEDIMENTS.
Wisconsin Univ.-Milwaukee. Center for Great Lakes Studies.
For primary bibliographic entry see Field 2H.
W89-11192

BIOGEOCHEMISTRY OF MARIANA ISLANDS COASTAL SEDIMENTS: TERRESTRIAL INFLUENCE ON DELTA-C13, ASH, CACO3, AL, FE, SI AND P.
Guam Univ., Agana. Marine Lab.
For primary bibliographic entry see Field 2J.
W89-11206

RELATIONSHIPS BETWEEN SI, AL, AND FE DEPOSITED ON FILTER-COVERED GLASS SUBSTRATES IN MARINE SEDIMENTS AND IN SUSPENSIONS OF SEDIMENTS AND STANDARD CLAYS.
State Univ. of New York at Stony Brook. Marine Sciences Research Center.
For primary bibliographic entry see Field 2L.
W89-11216

DISSOLVED NICKEL AND COBALT IN THE AQUATIC ENVIRONMENT AROUND MONACO.
International Lab. of Marine Radioactivity, Monaco-Ville (Monaco).
L. Huynh-Ngoc, N. E. Whitehead, M. Boussemart, and D. Calmet.
Marine Chemistry MRCHBD, Vol. 26, No. 2, p 119-132, March 1989. 5 fig, 5 tab, 39 ref.

Descriptors: *Geochemistry, *Path of pollutants, *Heavy metals, *Nickel, *Cobalt, *Aquatic environment, *Monaco, Rivers, Seawater, Interstitial water, Salinity, Estuaries, Particulate matter, Coastal waters, Diagenesis, Beaches, Path of pollutants.

Nickel and cobalt were measured in the river water, seawater, and interstitial water around Monaco, taking special care to prevent contamination. The river water values for the Var and Roya were, respectively, 304 and 392 ng/kg for Ni and mostly < 2 ng/kg for Co, which are quite low values, probably a result of the limestone environment. Model experiments in the laboratory showed that under conditions of varying salinity, as found in an estuary, Co and Ni are released from particulate matter at high salinities, but the percentages released are small. The coastal seawater samples contained concentrations of both elements the same as those in the open ocean or lower, even though taken from a beach. Interstitial water profiles are reported and show concentrations 30 times higher than open ocean values. The Co and Ni were partly present in the pore water in the form of a complex with stability constant about 10 to the 18th power, possibly as humic acids. Early diagenesis, therefore, causes some mobilization of Ni and Co into pore waters even in oxic environments near coasts. (Author's abstract)
W89-11217

RELATIONSHIP OF CATCHMENT TOPOGRAPHY AND SOIL HYDRAULIC CHARACTERISTICS TO LAKE ALKALINITY IN THE NORTHEASTERN UNITED STATES,
Geological Survey, Trenton, NJ. Water Resources Div.
D. M. Wolock, G. M. Hornberger, K. J. Beven, and W. G. Campbell.
Water Resources Research WRERAO, Vol. 25, No. 5, p 829-837, May 1989. 4 fig, 5 tab, 35 ref.

Descriptors: *Geomorphology, *Acid rain effects, *Geochemistry, *Alkaline water, *Hydraulic conductivity, *Soil water, *Earth-water interfaces, Surface water, Topography, Catchment areas, Water chemistry, Model studies, Lakes, Saturated flow, Hydrologic models.

How and whether base flow alkalinity of surface waters in the northeastern United States is related to indices of soil contact time and flow path partitioning that are derived from topographic and soils information was determined. The influence of topography and soils on catchment hydrology has been incorporate previously in the variable source area model TOPMODEL as the relative frequency distribution ln(a/Kb tan B), where ln is the Naperian logarithm, 'a' is the area drained per unit contour, K is the saturated hydraulic conductivity, b is the soil depth, and tan B is the slope. Using digital elevation and soil survey data, the ln (a/Kb tan B) distribution for 145 catchments was calculated. Indices of flow path partitioning and soil contact time were derived from the ln (a/Kb tan B) distributions and compared to measurements of alkalinity in lakes to which the catchments drain. It was found that alkalinity was, in general, positively correlated with the index of soil contact time, whereas the correlation between alkalinity and the flow path partitioning index was weak at best. A portion of the correlation between the soil contact time index and alkalinity was attributable to covariation with soil base saturation and cation exchange capacity, while another portion was found to be independent of these factors. Although the results indicate that catchments with long soil contact time indices are most likely to produce high alkalinity base flow, a sensitivity analysis of TOPMODEL suggests that surface waters of these same watersheds may be susceptible to alkalinity depressions during storm events, due to the role of flow paths. (Author's abstract)
W89-11253

REDOX-CONTROLLED MULTIPLE-SPECIES REACTIVE CHEMICAL TRANSPORT: 1. MODEL DEVELOPMENT.
California Univ., Berkeley. Dept. of Materials Science and Mineral Engineering.
W. L. Chen, and T. N. Narasimhan.
Water Resources Research WRERAO, Vol. 25, No. 5, p 869-882, May 1989. 4 fig, 68 ref.

Descriptors: *Solute transport, *Geochemistry, *Redox reactions, *Water chemistry, *Model studies, *Path of pollutants, *Oxidation-reduction potential, Chemical properties, Fate of pollutants, Physicochemical properties, Advection, Diffusivity, Thermodynamics, Equilibrium, Algorithms, Mathematical equations.

A redox-controlled multiple-species, multidimensional reactive chemical transport model, DYNAMIX, is developed. The model includes advection, diffusion-dispersion, transport of oxygen, oxidation-reduction and, as a consequence, acid-base reactions, aqueous complexation, precipitation-dissolution, and kinetic mineral dissolution. A partial equilibrium condition is incorporated into the model that accounts for both thermodynamic equilibrium and kinetic chemical interaction between aqueous and solid phases. The model solves for aqueous and mineral phase compositions as function of time and space. A correct mineral assemblage is automatically searched for based on the principle of minimized Gibbs free energy. The mass of chemicals is conserved in both aqueous and solid phases. A two-step dynamic mixing algorithm is used to solve the coupled transport and reaction equations. At each time step, the transport equation is first solved by the explicit difference method. The chemical equilibrium submodel is then called to calculate the distribution of chemical species under thermodynamic partial equilibrium conditions. By splitting the transport and reaction equations, the two-step method significantly reduces computational time and memory storage requirements, which allows DYNAMIX to efficiently handle two-dimensional or three-dimensional problems. (See also W89-11258) (Author's abstract)
W89-11257

REDOX-CONTROLLED MULTIPLE-SPECIES REACTIVE CHEMICAL TRANSPORT: 2. VERIFICATION AND APPLICATION.
California Univ., Berkeley. Dept. of Materials Science and Mineral Engineering.
W. L. Chen, and T. N. Narasimhan.
Water Resources Research WRERAO, Vol. 25, No. 5, p 883-910, May 1989. 35 fig, 12 tab, 45 ref.

Descriptors: *Solute transport, *Geochemistry, *Redox reactions, *Path of pollutants, *Water chemistry, *Model studies, *Model testing, *Oxidation-reduction potential, Path of pollutants, Physicochemical properties, Chemical properties, Multiphase flow, Diffusivity, Groundwater pollution, Fate of pollutants, Minerals, Hydrodynamics, Simulation.

A redox-controlled multiple-species, multidimensional reactive chemical transport model, DYNAMIX, has been presented in part 1 of this paper. In part 2, the model is checked against two other independently developed reactive chemical transport codes. Simulated results from DYNAMIX agree reasonably well with those obtained from the other two models. Two approaches for simulating redox reactions, an external approach (based on hypothetical electron activity) and an effective internal approach (based on conservation of electrons), have been examined. The results show that in the external approach, the simulated redox front is smeared out by diffusion and dispersion, whereas in the effective internal approach, the redox front is sharp and is controlled by the redox reactions. The evolution of solid phases from the two approaches give markedly different mineral assemblages. It is suggested that the external approach is of relevance in industrial processes such as electrometalurgy, in which mineral dissolution is driven by externally supplied electric power. The effective internal approach is applicable to hydrogeochemical systems (groundwater contamination, soil genesis, etc.) in which redox potential is dictated by the states of the redox species. The results also suggest that in the presence of precipitation, spreading due to hydrodynamic dispersion may be significantly inhibited. To demonstrate the applicability of DYNAMIX for realistic field problems, two field cases are simulated by this model. In the first case, the supergene enrichment of copper at Butte, Montana, the simulated mineral assemblages and their distribution agreed reasonably with the mineral assemblages and the ore grade observed in the filed. In the second case, involving two-dimen-

sional contaminant transport in a hypothetical aquifer, the simulated results suggest that DYNAMIX is capable of handling a realistic multi-dimensional field problem with several hundred grid blocks and time scales of practical interest. (See also W89-11257) (Author's abstract)
W89-11258

ESTIMATING CONSTITUENT LOADS.
Geological Survey, Reston, VA.
For primary bibliographic entry see Field 2J.
W89-11261

SPATIAL AND TEMPORAL GRADIENTS IN AQUIFER OXIDATION-REDUCTION CONDITIONS.
Illinois State Water Survey Div., Champaign.
M. J. Barcelona, T. R. Holm, M. R. Schock, and G. K. George.
Water Resources Research WRERAO, Vol. 25, No. 5, p 991-1003, May 1989. 6 fig, 4 tab, 50 ref.
USEPA cooperative agreements CR813149-01 and CR812165-02.

Descriptors: *Water chemistry, *Groundwater, *Geochemistry, *Oxidation-reduction potential, Chemical properties, Electrochemistry, Mathematical studies, Chemical reactions, Oxidation process, Water properties.

Principal oxidizing and reducing chemical species in groundwater were identified to determine the utility of platinum electrode (Eh) measurements to characterize subsurface redox conditions. Serial measurements of Eh and groundwater analyses were conducted in oxic and suboxic environments over more than a 2-year period for major ionic, oxidized, and reduce species. Vertical gradients in measured Eh values in the oxic groundwater environments can exceed -40mV/m depth. In the poorly poised, oxic groundwaters, the Eh measurements correlated reasonably well with calculated values based on analytical determinations of O2 and H2O2, which was detected persistently in the 0.00000001 to 0.000000001 M range. The equilibrium calculated Eh values from this and other redox couples did not correlated well with measured Eh values over the 2-year study period. In the suboxic range, the average calculated values based on the Fe(3+)/Fe(2+) coupled correlated well with average measured values. The results support the need to determine redox pairs in groundwater as a supplement to either calculated 'equilibrium' Eh values or Pt electrode Eh measurements. (Author's abstract)
W89-11266

INFLUENCE OF MINERAL WEATHERING REACTIONS ON THE CHEMICAL COMPOSITION OF SOIL WATER, SPRINGS, AND GROUNDWATER, CATOCTIN MOUNTAINS, MARYLAND.
Geological Survey, Tallahassee, FL.
For primary bibliographic entry see Field 5B.
W89-11288

MECHANISM OF THE AEROBIC FE(III)-P SOLUBILIZATION AT THE SEDIMENT-WATER INTERFACE.
Lund Univ. (Sweden). Inst. of Limnology.
For primary bibliographic entry see Field 2H.
W89-11304

EFFECTS OF SUBMERGENT MOSS ON SEDIMENT SULFATE REDUCTION RATES.
Wisconsin Dept. of Natural Resources, Madison.
For primary bibliographic entry see Field 2H.
W89-11342

CHEMICAL HYDROGEOLOGY IN NATURAL AND CONTAMINATED ENVIRONMENTS.
Geological Survey, Reston, VA.
W. Back, and M. J. Baedecker.
Journal of Hydrology JHYDA7, Vol. 106, No. 1/2, p 1-28, March 30, 1989. 10 fig, 51 ref.

Descriptors: *Geohydrology, *Geochemistry, *Groundwater pollution, *Water chemistry, *Path of pollutants, *Groundwater, *Contamination, Heterogeneity, Chemical reactions, Aquifers, Literature review.

A brief overview of the current state of chemical hydrology is provided by demonstrating some of the basic principles that have been developed and applied to groundwater systems. Current investigations and those selected from the literature demonstrate that heterogeneity increases in importance as the study site decreases from regional-scale to macroscale to microscale. Increased understanding of regional-scale flow systems is demonstrated by selection of investigations of carbonate and volcanic aquifers to show how application of present-day concepts and techniques can identify controlling chemical reactions and determine their rates; identify groundwater flow paths and determine flow velocity; and determine aquifer characteristics. The role of chemical hydrogeology in understanding geologic processes of macroscale systems is exemplified by selection of investigations in coastal aquifers. Phenomena associated with the mixing zone generated by encroaching sea water include an increase in heterogeneity of permeability, diagenesis of minerals, and formation of geomorphic features, such as caves, lagoons, and bays. Ore deposits of manganese and uranium, along with a simulation model of ore-forming fluids, demonstrate the influence of heteorogeneity and of organic compounds on geochemical reactions associated with genesis of mineral deposits. In microscale environments, importance of heterogeneity and consequences of organic reactions in determining the distribution and concentrations of constituents are provided by several studies, including infiltration of sewage effluent and migration of creosote in coastal plain aquifers. These studies show that heterogeneity and the dominance of organically controlled reactions greatly increase the complexity of investigations. (Author's abstract)
W89-11372

CHEMICAL CHARACTERISTICS AND SUSPENDED SEDIMENT LOAD OF MELTWATERS FROM A HIMALAYAN GLACIER IN INDIA.
Jawaharlal Nehru Univ., New Delhi (India). School of Environmental Sciences.
S. I. Hasnain, V. Subramanian, and K. Dhanpal.
Journal of Hydrology JHYDA7, Vol. 106, No. 1/2, p 99-108, March 30, 1989. 5 fig, 1 tab, 11 ref.

Descriptors: *Sediment load, *Glaciohydrology, *Water chemistry, *Glacial streams, *Meltwater, *Glaciers, *Suspended sediments, *India, Chemical analysis, Chemical properties, Himalayan Mountains, Cations, Anions.

Meltwaters draining from the snout of the Chhoto-Shigri glacier, Eastern Lahul Valley, Himachal Pradesh (India) were analyzed for major cations and anions. The glacier lies on the southern slope of the Himalayas at an elevation ranging between 4000 and 5000 m. The drainage area of the basin is 40 sq km while the glacier area is 10 sq km. Water quality was determined during the summer ablation period from 17 July to 17 August 1987. Meltwaters from the glacial surface have low solute content (electrical conductivity 5.0-5.92 micros/cm, Ca(++) 0.73 mg/l, Mg(++) 0.08 mg/l, Na(+) 0.36 mg/l, K(+) 0.34 mg/l). Whereas after passing through the galcier waters are chemically enriched (electrical conductivity 23.2-29.0 micros/cm, Ca(++) 0.9-9.9 mg/l, Mg(++) 0.5-0.35 mg/l, Na(+) 0.7-0.8 mg/l, K(+) 0.4-1.4 mg/l), The variations of solute concentration in meltwaters at the snout is related to its discharge. The water movement within the Chhota-Shigri Glacier appears to be through the subglacial and englacial channels. (Author's abstract)
W89-11376

FLUORINE OCCURRENCE IN GROUNDWATER IN ISRAEL AND ITS SIGNIFICANCE.
Geological Survey of Israel, Jerusalem.
U. Kafri, A. Arad, and L. Halicz.
Journal of Hydrology JHYDA7, Vol. 106, No. 1/2, p 109-129, March 30, 1989. 18 fig, 4 tab, 15 ref.

Descriptors: *Geochemistry, *Water chemistry, *Water quality, *Groundwater, *Israel, *Fluorine, *Aquifers, Aquicludes, Confined aquifers, Recharge, Temperature effects.

The connection between fluoride content in groundwaters is examined in relation to the respective aquifer or confining aquiclude. Meteoric waters recharging the aquifers of Israel become enriched with respect to F along their pathway from the intake area downstream. The source of the F is fluorine minerals, commonly present in rock formations. The mF/mCl ratio is apparently highest, up to 0.01, in the recharge area. This ratio decreases further downgradient when groundwater is still fresh, as a result of F leaching and partial removal, whereas the conservative Cl ion increases constantly. The positive temperature effect on fluorine solubility in carbonate aquifers appears to be nonapplicable for the temperature range of the aquifers of Israel. Variations in F content in natural groundwaters in Israel reflect interaction with different rock formations as well as different flow regimes. This is shown by a series of mF/mCl vs. Cl concentration-ratio lines. In fact, the F content in all of the fresh Judea Group carbonate aquifer and the central and northern clastical coastal aquifer is below the recommended level for drinking water. Their respective mF/mCl ratios are the lowest encountered. However, when confined by Senonian-Eocene chalks, the Judea group aquifer is enriched in F and exhibits higher mF/mCl ratios. F enrichment is also observed in basaltic aquifers. This is likewise the case of the clastic aquifers of southern Israel. (Author's abstract)
W89-11377

EFFECTS OF VARIATIONS IN RECHARGE ON GROUNDWATER QUALITY.
Kansas State Geological Survey, Lawrence.
For primary bibliographic entry see Field 6G.
W89-11378

HYDROGEOCHEMICAL CONTROLS FOR INORGANIC ALUMINUM IN ACIDIC STREAM AND SOIL WATERS AT TWO UPLAND CATCHMENTS IN WALES.
Institute of Hydrology, Wallingford (England).
For primary bibliographic entry see Field 2A.
W89-11380

PREDICTION OF SALT TRANSPORT DURING LEACHING OF SALINE SOILS FOR RECLAMATION.
Orissa Univ. of Agriculture and Technology, Bhubaneswar (India). Dept. of Soils and Agricultural Chemistry.
C. Misra, and S. N. Mahapatra.
Journal of Hydrology JHYDA7, Vol. 106, No. 1/2, p 185-189, March 30, 1989. 1 fig, 12 ref.

Descriptors: Solute transport, *Saline soils, *Land reclamation, *Mathematical models, *Soil water, *Leaching, Differential equations, Saline water, Laplace equation, Prediction, Irrigation water, Diffusion coefficient.

The Laplace transformation is used to obtain an analytical solution for the one-dimensional differential equation governing the transport of soluble salts through soil. The initial condition used is an exponentially varying salinity with depth. The velocity dependence of the apparent diffusion coefficient has been recognized and the best known formulation for computing salt profiles consequent upon leaching at realistic flow rates has been applied. The model also includes the case of irrigation water that may contain some salt and yet has to be used for leaching under special circumstances. (Author's abstract)
W89-11382

HISTORIC TRENDS IN LAKE MICHIGAN SILICA CONCENTRATIONS.
Michigan Univ., Ann Arbor. Great Lakes Research Div.
For primary bibliographic entry see Field 5C.
W89-11393

NITROGEN FIXATION AND NITROGEN ASSIMILATION IN A TEMPERATE SALINE ECOSYSTEM.
Dundee Univ. (Scotland). Dept. of Biological Sciences.
For primary bibliographic entry see Field 2G.
W89-11397

VANADYL IN NATURAL WATERS: ADSORPTION AND HYDROLYSIS PROMOTE OXYGENATION.
Eidgenoessische Anstalt fuer Wasserversorgung, Abwasserreinigung und Gewaesserschultz, Duebendorf (Switzerland).
For primary bibliographic entry see Field 5B.
W89-11405

ELECTRON MICROPROBE INVESTIGATION OF THE CHEMISTRY OF FERROMANGANESE COATINGS ON FRESHWATER SEDIMENTS,
Cambridge Univ. (England). Dept. of Earth Sciences.
For primary bibliographic entry see Field 5A.
W89-11406

DEUTERIUM IN THE DEAD SEA: REMEASUREMENT AND IMPLICATIONS FOR THE ISOTOPIC ACTIVITY CORRECTION IN BRINES.
Weizmann Inst. of Science, Rehovoth (Israel). Dept. of Isotope Research.
For primary bibliographic entry see Field 7B.
W89-11407

ATMOSPHERIC DEPOSITION OF BE7 AND BE10.
Carnegie Institution of Washington, DC. Dept. of Terrestrial Magnetism.
For primary bibliographic entry see Field 5B.
W89-11408

POLONIUM IN FLORIDA GROUNDWATER AND ITS POSSIBLE RELATIONSHIP TO THE SULFUR CYCLE AND BACTERIA.
Florida State Univ., Tallahassee. Dept. of Oceanography.
For primary bibliographic entry see Field 5B.
W89-11409

CHARACTERIZATION OF ORTHOPHOSPHATE RELEASE FROM DISSOLVED ORGANIC PHOSPHORUS BY GEL FILTRATION AND SEVERAL HYDROLYTIC ENZYMES.
Hokkaido Research Inst. for Environmental Pollution, Sapporo (Japan). Div. of Water Environment.
For primary bibliographic entry see Field 7B.
W89-11413

DISSOLVED ORGANIC COPPER ISOLATED BY C18 REVERSE-PHASE EXTRACTION IN AN ANOXIC BASIN LOCATED IN THE PETTAQUAMSCUTT RIVER ESTUARY.
Rhode Island Univ., Narragansett. Graduate School of Oceanography.
For primary bibliographic entry see Field 5A.
W89-11426

MAJOR, MINOR AND TRACE ELEMENT DETERMINATIONS FROM A NIGERIAN AQUATIC SEDIMENT.
Ahmadu Bello Univ., Zaria (Nigeria). Center for Energy Research and Training.
I. O. B. Ewa, and L. A. Dim.
Journal of Environmental Science and Health JESEDU, Vol. 24A, No. 3, p 243-254, April 1989. 2 fig, 3 tab, 10 ref.

Descriptors: *Water chemistry, *Geochemistry, *Trace elements, *Fluvial sediments, *Nigeria, *Dams, Aluminum, Titanium, Sodium, Potassium, Vanadium, Manganese, Barium, Samarium, Dysprosium, Uranium, Weathering, Sediment erosion.

Major, minor and trace quantities of ten stable elements were determined from the aquatic sediments of the Kubanni River Dam at Zaria, Nigeria. Sediment levels of Na, Al, K, Ti, V, Mn, Ba, Sm, Dy and U were determined by instrumental neutron activation analysis. Al, Ti, V, and Mn were identified in all the cores with a strong correlation of Al with Ti. Al had a mean value of 2.63% while V ranged from 30-40 ppm associated with acid eruptic granites and ryolites. Ti was detected at an average concentration of 4,316 ppm which falls within the range for granitic rocks. The concentration of the Rare Earth Elements (Sm, Dy, U) in the dam site sediments remained quite low (<39 ppm) with Sm localized only at the 8 cm core depth. A mean value of 26.37 ppm was obtained for U. Levels of Al, Ti, V, Mn are intimate indicators that the weathered depositions in the sediments have granitic provenance. A statistical analysis using Pearson's correlation coefficients was used to ascertain the degree of correlation of Al, Ti, V, and Mn. There were strong correlations for Ti and Al and also for Mn and Al while other pairs were negatively correlated. The reasons for this lack of strong and systematic trends in correlations are not obvious. Data for these stable elements will serve as reference levels for assessing further depositions in the aquatic environment as well as baseline information for the proposed continuous monitoring of the dam site. (Geiger-PTT)
W89-11428

IRON OXIDE PARTICULATES FORMED BY THE OXYGENATION OF NATURAL AND MODEL LAKEWATERS CONTAINING FE(II).
Freshwater Biological Association, Ambleside (England).
For primary bibliographic entry see Field 2H.
W89-11442

DETECTABILITY OF ACID PRODUCING REACTIONS IN NATURAL CLOUDS.
Brookhaven National Lab., Upton, NY. Environmental Chemistry Div.
For primary bibliographic entry see Field 5A.
W89-11451

ESTIMATES OF REGIONAL CONTRIBUTIONS TO WET ACID DEPOSITION IN WESTERN MASSACHUSETTS DURING THE SUMMER OF 1984.
General Motors Research Labs., Warren, MI. Environmental Science Dept.
For primary bibliographic entry see Field 5B.
W89-11453

MICROZONATION OF DENITRIFICATION ACTIVITY IN STREAM SEDIMENTS AS STUDIED WITH A COMBINED OXYGEN AND NITROUS OXIDE MICROSENSOR.
Aarhus Univ. (Denmark). Inst. of Ecology and Genetics.
For primary bibliographic entry see Field 2H.
W89-11511

METAL INTERACTIONS WITH MICROBIAL BIOFILMS IN ACIDIC AND NEUTRAL PH ENVIRONMENTS.
University of Western Ontario, London. Dept. of Geology.
F. G. Ferris, S. Schultze, T. C. Witten, W. S. Fyfe, and T. J. Beveridge.
Applied and Environmental Microbiology AEMIDF, Vol. 55, No. 5, p 1249-1257, May 1989. 6 fig, 3 tab, 41 ref.

Descriptors: *Acidic water, *Path of pollutants, *Geochemistry, *Metals, *Bacterial physiology, *Adsorption, *Mine wastes, Lakes, Plankton, Growth, Heavy metals, Manganese, Iron, Nickel, Copper, Sulfur, Hydrogen ion concentration.

Microbial biofilms were grown on strips of epoxy-impregnated filter paper submerged at four sites in water contaminated with metals from mine wastes. At two sample stations, the water was acidic (pH 3.1); the other sites were in a lake restored to a near neutral pH level by application of a crushed limestone slurry. In each case, the biofilms bound Mn, Fe, Ni, and Cu in excess of the amounts adsorbed by control strips covered with nylon filters (pore size, 0.22 microns) to exclude microbial growth; Co bound under neutral conditions but not under acidic conditions. Conditional adsorption capacity constants, obtained graphically from the data, showed that biofilm metal uptake at a neutral pH level was enhanced by up to 12 orders of magnitude over acidic conditions. Similarly, adsorption strength values were usually higher at elevated pH levels. In thin sections of the biofilms, encapsulated bacterial cells were commonly found enmeshed together in microcolonies. The extracellular polymers often contained iron oxide precipitates which generated weak electron diffraction patterns with characteristic reflections for ferrihydrite ($Fe_2O_3.H_2O$) at d equaling 0.15 and 0.25 nm. At neutral pH levels, these deposits incorporated trace amounts of Si and exhibited a granular morphology, whereas acicular crystalloids containing S developed under acidic conditions. (Author's abstract)
W89-11512

POSSIBLE ROLE OF CARBONATE DISSOLUTION IN ESTUARINE PHOSPHATE DYNAMICS.
Rijkswaterstaat, The Hague (Netherlands). Div. of Tidal Waters.
For primary bibliographic entry see Field 2L.
W89-11517

NITROGEN EXCHANGE BETWEEN A PORTION OF VEGETATED SALT MARSH AND THE ADJOINING CREEK.
South Carolina Univ., Columbia. Belle W. Baruch Inst. for Marine Biology and Coastal Research.
For primary bibliographic entry see Field 2L.
W89-11525

ORGANIC NITROGEN MINERALIZATION AND SUBSTRATE LIMITATION OF BACTERIA IN LAKE MICHIGAN.
National Oceanic and Atmospheric Administration, Ann Arbor, MI. Great Lakes Environmental Research Lab.
For primary bibliographic entry see Field 2H.
W89-11526

NITROGEN AND CARBON DYNAMICS IN C3 AND C4 ESTUARINE MARSH PLANTS GROWN UNDER ELEVATED CO2 IN SITU.
Smithsonian Environmental Research Center, Edgewater, MD.
For primary bibliographic entry see Field 2L.
W89-11530

RELATIONSHIP BETWEEN PARTICULATE CHEMISTRY AND AIR MASSES IN SOUTHERN INDIANA,
Purdue Univ., Lafayette, IN. Dept. of Agronomy.
For primary bibliographic entry see Field 5B.
W89-11540

EFFECTS OF MACROFAUNA EXCRETION AND TURBULENCE ON INORGANIC NITROGENOUS EXCHANGES IN THE WATER-SEDIMENT INTERFACE. EXPERIMENTAL APPROACH IN MICROCOSMS.
Centre d'Etudes d'Oceanographie et de Biologie Marine, Roscoff (France).
For primary bibliographic entry see Field 2L.
W89-11542

CHANGES IN NA, K, CA, MG AND AL CONTENT OF SUBMERSED LEAF LITTER, RELATED TO INGESTION BY THE AMPHIPOD GAMMARUS PULEX (L).
Royal Holloway and Bedford New Coll., Egham (England). Dept. of Biology.
For primary bibliographic entry see Field 2H.
W89-11545

PARTITION OF TRACE METALS BETWEEN DISSOLVED AND PARTICULATE PHASES IN

EUROPEAN COASTAL WATERS: A COMPILATION OF FIELD DATA AND COMPARISON WITH LABORATORY STUDIES,
Marine Lab., Aberdeen (Scotland).
For primary bibliographic entry see Field 5A.
W89-11568

EFFECT OF LOW ELECTROLYTE CONCENTRATION ON HYDRAULIC CONDUCTIVITY OF CLAY-SAND-HYDROXY POLYMERS SYSTEMS.
Volcani Inst. of Agricultural Research, Bet-Dagan (Israel). Inst. of Soil and Water.
For primary bibliographic entry see Field 2G.
W89-11573

PEDOGENIC CARBONATES IN A CALCIAQUOLL ASSOCIATED WITH A RECHARGE WETLAND.
Dow Chemical U.S.A., Midland, MI.
For primary bibliographic entry see Field 2G.
W89-11575

BACKGROUND TRENDS OF PH OF PRECIPITATION OVER INDIA.
Meteorological Office, Poona (India).
For primary bibliographic entry see Field 2B.
W89-11610

LONG-TERM EFFECTS OF POLLUTANTS ON PH OF RAIN WATER IN NORTH INDIA.
Indian Inst. of Tropical Meteorology, Poona.
For primary bibliographic entry see Field 5B.
W89-11611

SPREAD OF ACID RAIN OVER INDIA.
Indian Inst. of Tropical Meteorology, Poona.
For primary bibliographic entry see Field 5B.
W89-11612

MEASUREMENTS OF ELEMENTAL COMPOSITION OF AEROSOL MATTER AND PRECIPITATION FROM A REMOTE BACKGROUND SITE IN INDIA.
Bhabha Atomic Research Centre, Bombay (India). Pollution Monitoring Section.
For primary bibliographic entry see Field 5B.
W89-11613

PEAT CHEMISTRY OF A CONTINENTAL MIRE COMPLEX IN WESTERN CANADA.
Alberta Univ., Edmonton. Dept. of Botany.
For primary bibliographic entry see Field 2H.
W89-11615

ISOTOPE STUDY OF WATER BODIES ALONG A TRAVERSE OF SOUTHWESTERN CANADA,
Calgary Univ. (Alberta). Dept. of Physics.
For primary bibliographic entry see Field 2A.
W89-11678

INFLUENCE OF BACKGROUND ORGANIC MATTER ON GAC ADSORPTION,
Karlsruhe Univ. (Germany, F.R.).
For primary bibliographic entry see Field 5F.
W89-11739

IMPACT OF INCORPORATED ORGANIC MATTER ON THE DEWATERING CHARACTERISTICS OF ALUMINUM HYDROXIDE SLUDGES,
Woolpert Consultants, Dayton, OH.
For primary bibliographic entry see Field 5F.
W89-11740

SOLUTE TRANSPORT IN POROUS MEDIA WITH SOLID-LIQUID MASS TRANSFER LIMITATIONS: APPLICATION TO ION EXCHANGE.
SEPAREX, Champigneulles (France).
For primary bibliographic entry see Field 5B.
W89-11751

NATURAL AND ANTHROPOGENIC COMPONENTS IN BULK PRECIPITATION AT BLIDO (ARCHIPELAGO OF STOCKHOLM).
Stockholm Univ. (Sweden). Dept. of Geology.
For primary bibliographic entry see Field 5B.
W89-11770

PREDICTION OF PHOSPHATE TRANSPORT IN SMALL COLUMNS WITH AN APPROXIMATE SORPTION KINETICS MODEL.
Agricultural Univ., Wageningen (Netherlands). Dept. of Soil Science and Plant Nutrition.
For primary bibliographic entry see Field 5B.
W89-11775

MANGANESE OXIDATION MODEL FOR RIVERS,
Geological Survey, Doraville, GA.
For primary bibliographic entry see Field 5B.
W89-11798

GEOCHEMISTRY OF RADON-RICH WATERS FROM TWO-MICA GRANITES.
New Hampshire Univ., Durham.
T. J. Koch, D. A. Gust, and W. B. Lyons.
IN: Proceedings of the FOCUS Conference on Eastern Regional Ground Water Issues, September 27-29, 1988, Stamford, Connecticut. National Water Well Association, Dublin, Ohio, 1988. p 587-601, 9 fig, 11 tab, 44 ref.

Descriptors: *Geochemistry, *Radon, *Groundwater pollution, *Granite, *Water pollution sources, *Mica, Chemical reactions, Groundwater quality, Maine, New Hampshire, Radium, Chlorides, Sodium, Potassium, Uranium, Iron, Hydrogen, Geologic formations, Hydrolysis, Radioactivity.

Radon concentrations in groundwaters from two-mica granite are among the highest in the nation, averaging 25,000-35,000 picoCuries/L (pCi/L) with some in excess of 1,000,000 pCi/L. Previous studies in two-mica granite report significant correlations of both radon and radium with chloride and suggest that chloride may be important in the mobilization and concentration of these radionuclides. However, limited chemical data on these waters preclude an exact understanding of the chemical controls on mobilization, transportation, and concentration of radon. Groundwater was sampled from rock wells in the Sebago batholith in Maine and the Fitzwilliam pluton in New Hampshire. Both are two-mica granite plutons and sites of previous radon research. Temperature, pH, and specific conductance were measured in situ. Collected samples were analyzed for 222-Rn, 226-Ra, dissolved oxygen, alkalinity, Cl(-), Br(-), SiO2, phosphate, sulfate, Fe, major cations, and dissolved organic carbon. Chemical alteration of minerals in both the Sebago batholith and the Fitzwilliam pluton and is most severe in heavily fractured zones. The most abundant alteration product on fracture surfaces is illite. There is evidence which suggests that the amount of radon in groundwaters may be related to the amount of alteration of the rocks. The degree of alteration is represented on mineral equilibria diagrams by the concentrations of silicic acid and Na(+) or K(+) relative to H(+). Groundwaters in both the Sebago batholith and the Fitzwilliam pluton are enriched in chloride. Hydrolysis of biotite has been considered here as a possible source of excess Cl(-) in the Sebago pluton. However, data which might support this are inconclusive. (See also W89-11916) (Lantz-PTT)
W89-11949

1989 ANNUAL BOOK OF STANDARDS. SECTION 11: WATER AND ENVIRONMENTAL TECHNOLOGY, VOLUME 11.01.
American Society for Testing and Materials, Philadelphia, PA.
American Society for Testing and Materials, Philadelphia, Pennsylvania. 1989. 591p.

Descriptors: *Handbooks, *Pollutant identification, *Flow measurement, *Chemical properties, *Standards, *Water analysis, *Inorganic compounds, Classification, Chemical analysis, Hydrodynamics, Water sampling, Reagents, Statistical analysis, Corrosion.

The 1989 Annual Book of ASTM Standards consists of 67 volumes, divided among 16 sections. This is the first of two volumes of Section 11, Water and Environmental Technology, which are devoted to water standards. It contains formally approved ASTM standard classifications, guides, practices, specifications, test methods, and terminology and related material such as proposed standards. An ASTM standard represents a common viewpoint of those parties concerned with its provisions, namely, producers, users, consumers, and general interest groups. It is intended to aid industry, government agencies, and the general public. The use of an ASTM standard is purely voluntary. It is recognized that, for certain work or in certain regions, ASTM standard specifications may be either more or less restrictive than needed. The contents of this volume highlight: (1) definitions, specifications, reagents, and reporting results; (2) sampling and flow measurement of water and steam; (3) general properties of water; and (4) inorganic constituents. (See also W89-12001) (Lantz-PTT)
W89-12000

1989 ANNUAL BOOK OF STANDARDS. SECTION 11: WATER AND ENVIRONMENTAL TECHNOLOGY, VOLUME 11.02.
American Society for Testing and Materials, Philadelphia, PA.
For primary bibliographic entry see Field 5A.
W89-12001

2L. Estuaries

NITROGEN-FIXING HETEROTROPHIC BACTERIA IN COASTAL WATERS: A COMPARISON OF THE CONTRIBUTION MADE BY SEWAGE EFFLUENT IN A TEMPERATE AND A TROPICAL ENVIRONMENT.
Lancaster Univ. (England). Dept. of Biological Sciences.
For primary bibliographic entry see Field 5B.
W89-11114

MARINE HYDROCARBON-DEGRADING MICROORGANISMS: COMMUNITY STRUCTURE AND BIOMASS DETERMINATION.
Oklahoma Univ., Norman. School of Civil Engineering and Environmental Science.
For primary bibliographic entry see Field 5B.
W89-11130

PHOSPHORUS CONTENT OF ZOOPLANKTON FROM THE INLAND SEA OF JAPAN.
Hiroshima Univ. (Japan). Faculty of Applied Biological Science.
S. Uye, and O. Matsuda.
Journal of the Oceanographical Society of Japan NKGKB4, Vol. 44, No. 6, p 280-286, December 1988. 3 fig, 2 tab, 21 ref. Ministry of Education, Science and Culture, Project Nos. 60030046, 61030042, and 62030007.

Descriptors: *Nutrients, *Zooplankton, *Crustaceans, *Phosphorus, Copepods, Shrimp, Crabs, Mysids, Chaetognaths, Inland Sea of Japan.

Measurements of P content were made for 11 species of copepods, 2 species of mysids, shrimp (including mysis stage) and chaetognaths, and one species of Noctiluca, cirriped (naupliar stage) and crab (zoeal stage) from the Inland Sea of Japan. The body P content (in micrograms) is highly correlated to prosome length (L, in microns) for copepods, which is expressed as log P=2.90 x log L-9.34. Mean P content expressed as percent of dry weight is 1.30% for copepods, 1.39% for mysids, 0.63% for a decapod shrimp (Acetes japonicus), and 0.80% for chaetognaths. Noctiluca contains P of only 0.36%. The comparatively higher P content of suspension-feeding copepods may be related to the constant supply of P-rich phytoplankton in this region. (Author's abstract)

W89-11179

SEASONAL CHANGES IN SIZE-FRACTIONATED PRIMARY PRODUCTION AND NUTRIENT CONCENTRATIONS IN THE TEMPERATE NERITIC WATER OF FUNKA BAY, JAPAN.
Hokkaido Univ., Hakodate (Japan). Faculty of Fisheries.
For primary bibliographic entry see Field 5C.
W89-11180

CHANGES IN GAS EXCHANGE CHARACTERISTICS AND WATER USE EFFICIENCY OF MANGROVES IN RESPONSE TO SALINITY AND VAPOUR PRESSURE DEFICIT.
Australian Inst. of Marine Sciences, Townsville.
For primary bibliographic entry see Field 2I.
W89-11199

DETERMINATION OF SEDIMENT COMPOSITION AND CHRONOLOGY AS A TOOL FOR ENVIRONMENTAL IMPACT INVESTIGATIONS.
Consiglio Nazionale delle Ricerche, Padua (Italy). Ist. di Chimica e Tecnologia dei Radioelementi.
For primary bibliographic entry see Field 5A.
W89-11215

RELATIONSHIPS BETWEEN SI, AL, AND FE DEPOSITED ON FILTER-COVERED GLASS SUBSTRATES IN MARINE SEDIMENTS AND IN SUSPENSIONS OF SEDIMENTS AND STANDARD CLAYS.
State Univ. of New York at Stony Brook. Marine Sciences Research Center.
J. E. Mackin.
Marine Chemistry MRCHBD, Vol. 26, No. 2, p 101-117, March 1989. 7 fig, 38 ref, append. ACS-PRF Grants 15882-G2, 19131-ACS; NSF Grant OCE-83-09551.

Descriptors: *Geochemistry, *Silicon, *Aluminum, *Iron, *Marine sediments, *Clays, *Suspended sediments, Silicates, Interstitial water, Nitric acid, Chemical properties, Diagenesis, Sedimentation.

Past interpretations regarding the composition of aluminosilicate precipitates that rapidly form in marine sediments have relied on relationships between dissolved Al and Si concentrations measured in sediment pore waters. As this method is not always appropriate, the possibility of directly measuring Si/Al and Si/Fe precipitation ratios was examined. Glass plates and glass beads were placed into probes that were covered with filters and inserted into sediments and clay and sedimentary suspensions. The probes were incubated for up to 1.5 months and the glass substrates were then extracted in 0.1 N HCl. Results showed that extractable Al and Si accumulated on glass substrates in amounts that usually exceeded 'blank' values (glass placed in contact with Si-containing solutions, but without sedimentary minerals), but Fe was measurable only on glass substrates placed in contact with dissolved Fe-containing pore waters. The Si/(Al + Fe) deposition ratio was nearly a constant at approx. 1:1, independent of pH and dissolved Si concentration. This result agrees with previous interpretations of authigenic mineral compositions based upon dissolved Al-Si relations in sediments. Inverse Al-Fe correlations in materials detected on the glass are consistent with observations regarding compositional variations of Fe-rich authigenic minerals such as glauconite and chamosite and coating materials on mineral grains formed in both shallow and deeply buried deposits. (Author's abstract)
W89-11216

DISSOLVED NICKEL AND COBALT IN THE AQUATIC ENVIRONMENT AROUND MONACO.
International Lab. of Marine Radioactivity, Monaco-Ville (Monaco).
For primary bibliographic entry see Field 2K.
W89-11217

GROWTH RESPONSE OF BACTERIA TO EXTRACELLULAR PRODUCTS OF BLOOM ALGAE.
Kyoto Univ. (Japan). Dept. of Fisheries.
For primary bibliographic entry see Field 5C.
W89-11293

DEVELOPMENT OF BACTERIOPLANKTON DURING WINTER AND EARLY SPRING AT THE ENTRANCE TO THE GULF OF FINLAND, BALTIC SEA.
Tvarminne Zoological Station (Finland).
J. Kuparinen.
Internationale Vereinigung fur Theoretische und Angewandte Limnologie, Verhandlungen IVTLAP, Vol. 23, No. 4, p 1869-1878, December 1988. 4 fig, 5 tab, 31 ref.

Descriptors: *Aquatic bacteria, *Plankton, *Baltic Sea, *Finland, *Ice cover, *Ice breakup, Biomass, Productivity, Chlorophyll, Seasonal variation, Bacterial physiology.

In order to study the control of the bacterioplankton growth by phytoplankton substrate release (and chemical and physical factors), bacterioplankton development was followed in the Tvarminne Stodfjard during early spring till the break up of the ice when zooplankton grazing is expected to be at a minimum. Bacterioplankton biomass and productivity were measured by the acridine orange and the 3H-thymidine incorporation techniques, respectively, from the winter stage to the breakup of the ice cover in spring. During the ice-covered period, when concentrations of inorganic nutrients were high and temperatures below 0 C, bacteria numbers, biomass and production were low and stable. The maximum bacterial number and biomass values of 5,300,000 cells/ml and 115 mg C/cu m, respectively, were recorded at the chlorophyll-a maximum. The maximum bacterial production of 23 mg C/cu m/d was recorded prior to the chlorophyll maximum, during the outflow of less saline water below the ice (0.5 m). The mean bacterial cell volume increased during the phytoplankton bloom development. Due to the strong seasonal variation in bacterial cell size, the use of a single conversion factor, throughout the year may cause a serious error in biomass and production estimates. The direct conversion of thymidine incorporation to carbon production gave higher rates than if conversion of thymidine incorporation to cell growth, cell volume to cell carbon and cell volume conversions were used. The data show an intimate relationship between the phytoplankton and bacterioplankton during the development of the spring phytoplankton bloom, phytoplankton exudation control bacterial growth. (Miller-PTT)
W89-11311

ECOLOGY OF DUNALIELLA SPECIES (CHLOROPHYTA, VOLVOCALES) IN THE COASTAL SALT LAKE, HUTT LAGOON, WESTERN AUSTRALIA,
T. P. Moulton, M. A. Burford, and T. R. Sommer.
Internationale Vereinigung fur Theoretische und Angewandte Limnologie, Verhandlungen IVTLAP, Vol. 23, No. 4, p 1908-1911, December 1988. 3 tab, 9 ref.

Descriptors: *Algal growth, *Chlorophyta, *Lagoons, *Australia, *Saline water, Ecology, Vertical distribution, Water chemistry, Salinity, Predation, Limiting nutrients.

The water chemistry, limiting nutrients, and vertical distribution as well as the competition between Dunaliella salina and D. viridis are discussed for the Hutt Lagoon (Western Australia). D. salina and D. viridis coexist as the dominant eucaryotic organisms in the hypersaline, ephermal lake. In the normal annual cycle, the lake is dry in the summer and fills in winter to a maximum depth of approximately 0.7 m. The salinity of the main water body is close to saturated salt (300 g/L) for much of the year and usually remains above approximately 200 g/l. Under these conditions, D. salina and D. viridis are little affected by competitors (other algae) and predators (Protozoa and Artemia). In peripheral water bodies at lower salinities, (less than 200 g/L) predation by Protozoa and Artemia has a major effect on populations of D. salina and D. viridis. Other algae become common also at lower salinities. In the summer, when the lake dries out, both species of Dunaliella exist within and below the layer of precipitated halite. Cysts of both species have been observed, but are not the dominant form that survives drying out; the naked, flagellated cells are observed most commonly in this situation. (Author's abstract)
W89-11316

RECYCLING OF MARINE ELEMENTS TRANSPORTED INTO FRESHWATER SYSTEMS BY ANADROMOUS SALMON.
Juneau Center for Fisheries and Ocean Sciences, AK.
For primary bibliographic entry see Field 2H.
W89-11339

STUDIES ON PERIPHYTON ALGAE IN THE PETROLEUM OIL SPILLAGES AREA OF THE NIGER DELTA AQUATIC SYSTEM.
Rivers State Univ. of Science and Technology, Port Harcourt (Nigeria).
For primary bibliographic entry see Field 5C.
W89-11340

SOME ENVIRONMENTAL FACTORS AFFECTING SURVIVAL OF FECAL PATHOGENS AND INDICATOR ORGANISMS IN SEAWATER.
Alexandria Univ. (Egypt). Higher Inst. of Public Health.
For primary bibliographic entry see Field 5B.
W89-11358

MODEL FOR THE ESTIMATION OF ANNUAL PRODUCTION RATES OF MACROPHYTE ALGAE,
Universidade Nova de Lisboa (Portugal). Faculdade de Ciencias e Tecnologia.
J. G. Ferreira, and L. Ramos.
Aquatic Botany AQBODS, Vol. 33, No. 1/2, p 53-70, March 1989. 4 fig, 6 tab, 31 ref.

Descriptors: *Estuaries, *Aquatic plants, *Macrophytes, *Algae, Biomass, Aquatic productivity, Abiotic factors, Seasonal variation, Zooplankton, Portugal, Time series analysis, Light penetration, Estuarine environment.

Data on seasonal biomass variation, short-term productivity experiments and different abiotic factors are used to estimate annual productivity for three macrophyte species. Although the accuracy of the estimates is subject to the limitations of the methodology applied, an example is given of the importance of annual productivity data for the determination of the role of macrophytes in estuarine ecosystems. The data presented and discussed were obtained in the Tagus Estuary (Portugal). The observed variation in biomass for the three species appears to be conditioned by the seasonal nature of factors controlling production in any temperate estuary. There is a spring increase in biomass associated with the increase in day length, irradiance and air and water temperatures; this increase is most significant in Fucus and Ulva. There is subsequent fall in biomass, owing to the appearance of herbivorous zooplankton; this is a more pronounced in Ulva, which may be preferentially grazed owing to its distromatic structure and also more readily detached from the substrate. A subsequent summer peak in biomass occurs in all species, probably linked to the decline in grazers. The values obtained for the mean net and gross primary productivity of the three species show that, for a range of temperatures and light intensities, G. verrucosa and U. lactuca have a consistently higher primary productivity than F. vesiculosus, with all the species having roughly similar coefficients of variation. A time series of k values, obtained at high and low tide during an 18-month sampling period was used. The temporal variation of k, the light extinction coefficient, was examined in detail, since this parameter will be extremely variable in an estuarine ecosystem. (Miller-PTT)
W89-11365

SEASONAL PLANT WATER RELATIONS IN A SOUTH AFRICAN MANGROVE SWAMP.
Durban-Westville Univ. (South Africa). Dept. of Botany.
G. Naidoo.
Aquatic Botany AQBODS, Vol. 33, No. 1/2, p 87-100, March 1989. 7 fig, 31 ref.

Descriptors: *Soil-water-plant relationships, *Mangrove swamps, *South Africa, Leaves, Phenology, Soil water potential, Conductivity, Seasonal variation, Soil water, Swamps.

Seasonal water relations were monitored at monthly intervals for a year on Avicennia marina (Forsk.) Vierh., Rhizophora mucronata Lam. and Bruguiera gymnorrhiza (L.) Lam. in a mangrove swamp in Durban, South Africa. Observations and measurements were made of phenology, climatic conditions, soil moisture, soil water potential, electrical conductivity, leaf water potential and leaf conductance. Soil salinities showed distinct seasonal trends being lower during the hot, wet summer and two-fold to three-fold higher during the cool dry winter. Soil water potentials ranged from -1.33 to 3.48 MPa and paralleled those of soil salinity. Soil moisture content ranged from 19 to 40% and did not show any seasonal variation. Minimum leaf water potentials at dawn varied from -2.07 to 4.38 MPa with no distinct seasonal trends. There was no relationship between leaf water potential and soil salinity or soil water potential. Leaf conductance exhibited distinct seasonal trends, being higher in summer as a result of high evaporative demand, lower soil salinities and higher soil water potentials. The results indicate that seasonal trends in soil and plant water relations are similar for all three mangrove species. (Author's abstract)
W89-11366

VERTICAL DISTRIBUTION AND RESOURCE ALLOCATION OF RUPPIA MARITIMA L. IN A SOUTHERN BRAZILIAN ESTUARY.
Fundacao Univ., Rio Grande (Brazil). Lab. de Botanica Marinha.
C. S. B. Costa, and U. Seeliger.
Aquatic Botany AQBODS, Vol. 33, No. 1/2, p 123-129, March 1989. 3 fig, 1 tab, 19 ref.

Descriptors: *Sea grasses, *Plant growth, *Brazil, *Estuaries, Aquatic plants, Vertical distribution, Light intensity, Transparency, Aquatic habitats.

The vertical distribution and resource allocation of Ruppia maritima L. were studied in the Patos Lagoon estuary (Brazil). Light intensities, water transparency and water depths at the plant site were measured daily during the growth period from August 1980 to January 1981. Plant samples from 4 water depths (0.25-0.70 m below mean low water) were collected during the growth and reproductive peak of the population in January 1981. The upper limit of the plants was at water depths (0.25 m) where aerial exposures of the plants were no longer than 50% of the total time during the growth period. Highest vegetative shoot numbers and biomass were found at 0.40-m water depth. Reduced vegetative growth below 0.55 m appeared to be related to light intensity. Based on the average extinction coefficient and photosynthetically active light below the surface during the flowering period, optimal growth (vegetative and flowering) (0.40 m) and the lower growth limit of Ruppia (0.70 m) occurred at 4860-5760 and 1660-1970 lux, respectively. The high proportion (90%) of resource allocations into flowering shoots and maximum number of flowers and fruits at lowest depth, as well as their absence at 0.55 m water depth, suggests the existence of different strategies in intertidal and subtidal habitats. (Author's abstract)
W89-11369

CONTINUOUS INFLOW OF SEAWATER AND OUTFLOW OF BRACKISH WATER IN THE SUBSTRATUM OF THE KARSTIC ISLAND OF CEPHALONIA.
Montpellier-2 Univ. (France). Lab. d'Hydrogeologie.
For primary bibliographic entry see Field 2F.
W89-11379

IMPROVEMENTS IN THE BENTHIC FAUNA OF THE TEES ESTUARY AFTER A PERIOD OF REDUCED POLLUTION LOADINGS.
Imperial Chemical Industries Ltd., Brixham (England). Brixham Lab.
For primary bibliographic entry see Field 5G.
W89-11384

PHYSICAL, CHEMICAL AND BIOLOGICAL CHARACTERIZATION OF THE USHANT TIDAL FRONT,
Museume National d'Histoire Naturelle, Paris (France).
G. Grepma.
Internationale Revue der Gesamten Hydrobiologie IGHYAZ, Vol. 73, No. 4, p 511-536, 1988. 12 fig, 2 tab, 78 ref.

Descriptors: *Stratification, *Surveys, *Tidal effects, *English Channel, Physical properties, Chemical properties, Biological properties, Seawater, Carbon cycle, Nitrogen cycle, Phytoplankton, Zooplankton, Nutrients, Enrichment, Thermocline, Biomass.

A multi-disciplinary study was carried out during the summer of 1982 in the area of Ushant tidal front at the entrance of the English Channel. The Ushant front is a shallow-sea, tidal front. During the warmer half of the year, it separates cool, well-mixed coastal waters from offshore stratified waters. It stretches between Brittany and Great Britain across the entrance of the English Channel over depths of about 100 m. The stratified water masses (West of the front) and the mixed water masses (East of it) are characterized with respect to their main physical, chemical and biological properties and a comparative budget of organic carbon is presented. A single West-East transect was selected in order to characterize as thoroughly as possible the stratified area and the mixed area. Several physiological, biochemical or taxonomical indices of phytoplankton and zooplankton populations are investigated. The effects of the tidal regime on space-time variability and nutrient enrichment are emphasized. Measurements include: (1) optical diffusivity, (2) Coulter counting, (3) nutrient analysis, (4) free and particle-bound bacteria, in terms of abundance, size and biomass, (5) carbon, nitrogen, carbohydrates and protein content of the particulate matter, (6) adenylate energy charge, (7) taxonomical composition and abundance of phytoplankton, mesozooplankton and ichthyoplankton, (8) chlorophyll content of photosynthetic carbon uptake (14C) and nitrate and ammonium uptakes (15N) under simulated in situ conditions, and (9) digestive enzyme activity of mesozooplankton. The main features are compared for the S (stratified station) and M (mixed station) areas. Although most concentrations and biomasses exhibited some increase in the vicinity of the front, it could not be firmly ascertained whether growth rates are higher there. Frontal effects and thermocline effects appear to be closely related. A partial budget of organic carbon is presented, which results in unbalanced phytoplankton ratios in S and M. Ammonium recycling proves to be essential to the nitrogen budget, particularly in S. Emphasis is put on the respective enriching effects of the semi-diurnal and the semi-monthly tidal periodicities. (Miller-PTT)
W89-11391

SALINITY AND FLOODING LEVEL AS DETERMINANTS OF SOIL SOLUTION COMPOSITION AND NUTRIENT CONTENT IN PANICUM HEMITOMUM.
Louisiana State Univ., Baton Rouge. Lab. for Wetland Soils and Sediments.
T. C. Feijtel, P. A. Moore, K. McKee, and I. Mendelssohn.
Plant and Soil PLSOA2, Vol. 114, No. 2, p 197-204, February 1989. 6 fig, 7 tab, 24 ref.

Descriptors: *Wetlands, *Marsh plants, *Salinity, *Interstitial water, *Nutrients, *Flooding, Hydrogen ion concentration, Marshes, Capillary conductivity, Magnesium, Calcium, Potassium, Manganese, Copper, Regression analysis.

A greenhouse experiment was conducted to examine the effects of salinity and flooding level on interstitial solute speciation and solute uptake by Panicum hemitomum grown on intact marsh substrates. The experimental set-up consisted of a factorial arrangement of treatments (5 salinity levels at 3 flooding levels) with 4 replications. Salinity treatments with the addition of salt (Instant Ocean) successfully increased interstitial pore water conductivities and resulted in significantly different treatment means. Redox potentials and proton activities were significantly higher in the drained treatment, with only minor differences between the two flooded treatments. There was no significant pH effect due to salinity, although a significant interaction between salinity and flooding level was observed. Analysis of variance suggested that electro-chemical and interstitial solute behavior could be described by salinity and flooding treatments. GEOCHEM calculations were performed in order to relate leaf concentrations to ion activities in interstitial soil solutions. Leaf contents of Mg, Ca, K, Mn, and Cu were significantly correlated with the activities of corresponding ions in the interstitial pore water. However, most of the variability in leaf metal content could be accounted for by treatment effects. Regression analysis showed that the ion activities explained less than 25% of the variability in leaf metal content. (Author's abstract)
W89-11424

DISSOLVED ORGANIC COPPER ISOLATED BY C18 REVERSE-PHASE EXTRACTION IN AN ANOXIC BASIN LOCATED IN THE PETTAQUAMSCUTT RIVER ESTUARY.
Rhode Island Univ., Narragansett. Graduate School of Oceanography.
For primary bibliographic entry see Field 5A.
W89-11426

EFFECT OF SALINITY ON FREE AMINO ACIDS IN THE PRAWN PALAEMON ELEGANS (RATHKE),
Innsbruck Univ. (Austria). Inst. fuer Zoologie.
For primary bibliographic entry see Field 8I.
W89-11447

STATIC EQUILIBRIUM BAYS: NEW RELATIONSHIPS.
Western Australia Univ., Nedlands. Dept. of Civil Engineering.
J. R. Hsu, R. Silvester, and Y. Xia.
Journal of Waterway, Port, Coastal and Ocean Engineering (ASCE) JWPED4, Vol. 115, No. 3, p 285-298, 1989. 10 fig, 2 tab, 20 ref.

Descriptors: *Beach erosion, *Shore protection, *Bays, *Geomorphology, *Coasts, Logarithmic spiral, Model studies, Crenulate-shaped bays, Graphical methods, Erosion, Wave direction.

Bays as a predominant physical feature of the coastlines of the world have been recognized for some 30 years. Shape of bays has been equated to a logarithmic spiral but information presented indicates it is not uniformly applicable. The following observations have been made concerning bay dynamics: (1) Crenulate-shaped bays are widespread and information is available to explain their formation; (2) Bays are natural features, which points to their use in stabilizing procedures employing beaches as natural protection; (3) Model studies can be used to derive the shape of bays in static equilibrium; (4) The previously accepted bay shape of the logarithmic spiral should be replaced by graphs, which require arcs to be drawn from the upcoast headland at various angles to the wave crest alignment through the up-coast control point; (5) This new procedure permits the shape to be determined for static equilibrium, which is indicative of bay stability, since it can erode back to this limiting curvature; (6) The indentation, measured normal to the control line, taken as a ratio to its length is related to wave obliquity, from which stability can be gaged. (See also W89-11471) (White-Reimer-PTT)
W89-11470

APPLICATIONS OF HEADLAND CONTROL.
Western Australia Univ., Nedlands. Dept. of Civil

Engineering.
For primary bibliographic entry see Field 2J.
W89-11471

DETECTION OF PILUSLIKE STRUCTURES ON CLINICAL AND ENVIRONMENTAL ISOLATES OF VIBRIO VULNIFICUS.
Texas Univ. Medical School at Houston.
For primary bibliographic entry see Field 5C.
W89-11502

POSSIBLE ROLE OF CARBONATE DISSOLUTION IN ESTUARINE PHOSPHATE DYNAMICS.
Rijkswaterstaat, The Hague (Netherlands). Div. of Tidal Waters.
V. N. de Jonge, and L. A. Villerius.
Limnology and Oceanography LIOCAH, Vol. 34, No. 2, p 332-340, March 1989. 9 fig, 32 ref.

Descriptors: *Phosphates, *Carbonates, *Estuarine environment, *Cycling nutrients, Adsorption, Calcite, Clays, Iron, Acidity, Dynamics, Carbon dioxide, Sediment transport, Mineralization, Accumulation, The Netherlands.

Field observations on the phosphate distribution in the Ems estuary (The Netherlands) show a nonconservative concentration gradient, with high summer values in the middle reaches. Experiments indicate the existence of two antagonistic mechanisms that can regulate the phosphorus cycle. Calcite is formed at sea and in the estuary and transported onshore and to the upper reaches of the estuary like other suspended matter. During this transport, part of the phosphate adsorbs onto calcite. Because pH is lower in the upper reaches of the estuary, some of the calcite dissolves and consequently some of the phosphate desorbs. Other suspended matter components, such as clay minerals and iron oxyhydroxide, can also adsorb phosphate. The conditions in the upper reaches of the estuary (lower salinities and pH) are particularly favorable for these minerals to adsorb the phosphate that is available there as a result of calcite dissolution. Thus, during transport upstream, part of the calcite-bound phosphate fraction of the suspended matter switches to adsorption sites of suspended noncalcite minerals, producing the nonconservative concentration gradient in phosphate along the estuary. This process of phosphate release may be simulated by high carbon dioxide production resulting from the biological mineralization of organic matter in the middle and upper reaches of the estuary. The processes of sediment transport and phosphate adsorption and desorption favor the accumulation of marine phosphates as well as retention of fluvial phosphates in the estuary. (Author's abstract)
W89-11517

TIDALLY INDUCED ESTUARINE PHYTOPLANKTON PATCHINESS.
Charleston Coll., SC. Grice Marine Biological Lab.
P. Dustan, and J. L. Pinckney.
Limnology and Oceanography LIOCAH, Vol. 34, No. 2, p 410-419, March 1989. 12 fig, 1 tab, 25 ref.

Descriptors: *Estuarine environment, *Phytoplankton, *Ecological distribution, *Tidal effects, Chlorophyll a, Tidal currents, Tidal amplitude, Coastal waters, Harbors.

The patchiness of phytoplankton in Charleston Harbor, as measured by the distribution of chlorophyll a, is coupled to the periodicity of the tidal cycle. Phytoplankton aggregations occur at frontal zones that form on the flood when river and tidal flow are in opposition. The magnitude and variability of the chlorophyll distribution decrease during the ebb, and phytoplankton patches do not form at frontal zones. Tidal current velocities and not tidal heights appear to be the important ecological variables. This tidally driven periodic aggregation of phytoplankton represents an interaction between physical forcing functions and biological activity that may focus and locally intensify the trophodynamics of the pelagic component of the Charleston Harbor estuary. Tidally induced aggregation and subsequent offshore transport on the ebb may, in part, provide the mechanism that links the scale lengths of estuarine and coastal phytoplankton variability. (Author's abstract)
W89-11522

NITROGEN EXCHANGE BETWEEN A PORTION OF VEGETATED SALT MARSH AND THE ADJOINING CREEK.
South Carolina Univ., Columbia. Belle W. Baruch Inst. for Marine Biology and Coastal Research.
G. J. Whiting, H. N. McKellar, J. D. Spurrier, and T. G. Wolaver.
Limnology and Oceanography LIOCAH, Vol. 34, No. 2, p 463-473, March 1989. 9 fig, 4 tab, 31 ref. NSF Grant BSR 81-19752.

Descriptors: *Salt marshes, *Nitrogen cycle, *Streams, Vegetation, Spartina, Tides, Ammonium, Nitrates, Nitrites, Particulate matter, Water level, Rainfall, Nutrients.

Net exchange of nitrogen between a portion of vegetated salt marsh (dominated by Spartina alterniflora) and the adjacent tidal creek was measured. During tidal inundation, the marsh imported ammonium, nitrate + nitrite, and particulate nitrogen and exported dissolved organic nitrogen over an annual cycle. The low marsh (characterized by the tall form of S. alterniflora) had higher uptake and release rates compared to high marsh areas dominated by shorter forms of S. alterniflora. When creek-water levels were below the marsh surface during the late ebb and early flood, residual water on the marsh surface drained into the tidal creek and exported substantial amounts of particulate and dissolved organic nitrogen but relatively small amounts of dissolved inorganic nitrogen. Rainfall during exposure of the marsh surface increased particulate nitrogen export to the tidal creek 40-fold. With respect to tidal exchange via inundation and drainage, the vegetated marsh exported about 4.5 g N/sq m/yr, largely as dissolved organic nitrogen. Results suggest that the seasonal pattern of inorganic nitrogen import is more dependent on the concentration of nutrients in water flooding the marsh than on the seasonal demand of primary producers in the marsh. (Author's abstract)
W89-11525

NITROGEN AND CARBON DYNAMICS IN C3 AND C4 ESTUARINE MARSH PLANTS GROWN UNDER ELEVATED CO2 IN SITU.
Smithsonian Environmental Research Center, Edgewater, MD.
P. S. Curtis, B. G. Drake, and D. F. Whigham.
Oecologia OECOBX, Vol. 78, No. 3, p 297-301, March 1989. 4 fig, 2 tab, 36 ref.

Descriptors: *Nitrogen cycle, *Carbon cycle, *Estuaries, *Marsh plants, *Carbon dioxide, Spartina, Bulrushes, Plant tissues, Nitrogen, Carbon, Growth, Wetlands.

Carbon dioxide concentrations were elevated in three estuarine communities for an entire growing season. Open top chambers were used to raise CO2 concentrations ca. 336 ppm above ambient in monospecific communities of Scirpus olneyi (C sub 3) and Spartina patens (C sub 4), and a mixed community of S. olneyi, S. patens, and Distichlis spicata (C sub 4). Nitrogen and carbon concentration (% wt) of aboveground tissue was followed throughout growth and senescence. Green shoot %N was reduced and %C was unchanged under elevated CO2 in S. olneyi. This resulted in a 20-40% increase in tissue C/N ratio. There was no effect of CO2 on either C sub 4 species. Maximum aboveground N (g/sq m) was unchanged in S. olneyi, indicating that increased productivity under elevated CO2 was dependent on reallocation of stored N. There was no change in the N recovery efficiency of S. olneyi in pure stand and a decrease in the mixed community. Litter C/N ratio was not affected by elevated CO2, suggesting that decomposition and N mineralization rates will also remain unchanged. Continued growth responses to elevated CO2 could, however, be limited by the ability of S. olneyi to increase the total aboveground N pool. (Author's abstract)
W89-11530

EFFECTS OF MACROFAUNA EXCRETION AND TURBULENCE ON INORGANIC NITROGENOUS EXCHANGES IN THE WATER-SEDIMENT INTERFACE. EXPERIMENTAL APPROACH IN MICROCOSMS.
Centre d'Etudes d'Oceanographie et de Biologie Marine, Roscoff (France).
M. Regnault, R. Boucher-Rodini, G. Boucher, and P. Lasserre.
Cahiers de Biologie Marine CBIMA5, Vol. 29, No. 4, p 427-444, 1988. 3 fig, 3 tab, 41 ref. Electricite de France Grant n 2G-3661.

Descriptors: *Marine environment, *Sediment-water interfaces, *Turbulent flow, *Excretion, *Cycling nutrients, *Ammonia, *Nitrates, Aquatic environment, Aquatic animals, Crabs, Oysters, Water column, Interstitial water.

The respective effects of macrofauna excretion and turbulence on the NH4(+) and NO3(-) fluxes occurring at the water-sediment interface of an oyster-bed were studied, using marine microcosms in which this interface was reconstituted. Experiments were performed in winter and summer conditions. In the presence of macrofauna (Carcinus maenas or Crassostrea gigas), the NH4(+) content of the water column and of pore-water markedly increased. NH4(+) fluxes at the water-sediment interface were 1 and 2 orders of magnitude greater than in the absence of macrofauna, in winter and summer, respectively. A turbulence simulation in the water column leads simultaneously to a marked increase of the water column NH4(+) content and a decrease of the pore-water NH4(+) content. According to the duration of the experimental turbulence, these nutrient exchanges likely resulted from a physical process (sediment resuspension) rather than biological processes. In contrast to NH4(+), NO3(-) content of pore-water and water column was not significantly modified by either turbulence or macrofauna. Ammonia excretion rate of crab and oyster was to a varied extent influenced by turbulence according to the season and the species considered. (Author's abstract)
W89-11542

PHYTOPLANKTON POPULATION DENSITY AND VOLUME AS INDICATORS OF EUTROPHICATION IN THE EASTERN PART OF THE ADRIATIC SEA.
Biological Inst., Dubrovnik (Yugoslavia).
D. Vilicic.
Hydrobiologia HYDRB8, Vol. 174, No. 2, p 117-132, April 15 1989. 2 fig, 7 tab, 49 ref.

Descriptors: *Population density, *Ecosystems, *Bioindicators, *Phytoplankton, *Population dynamics, *Eutrophication, *Adriatic Sea, Biomass, Aquatic populations, Aquatic environment, Classification, Marine environment, Trophic level, Physiological ecology, Municipal wastewater, Red tide, Statistical analysis.

Population density and volume biomass of microplankton, nanoplankton and total phytoplankton were analyzed at 14 stations along the eastern part of the Adriatic Sea. At each station, five parameters of phytoplankton quantity were analyzed: (1) microplankton population density; (2) microplankton volume; (3) nanoplankton population density; (4) nanoplankton volume; and (5) total phytoplankton volume. The minimum, maximum and most frequent phytoplankton quantities are proposed as characteristic and indicative values of ecosystem trophic level and its metabolism. Based upon frequency distribution, four categories of ecosystems were established in the investigated area. Criteria for ecosystem categorization and biological evaluation of eutrophication are proposed; stations with lower trophic level and very small, small, or moderate phytoplankton quantity may be included in categories I, II and III. Category IV includes urban sewage waters influenced ecosystems or those being naturally well eutrophicated, where highest possible phytoplankton quantity, including red tides, are most likely to occur. In more eutrophicated waters, minimum, most frequent and maximum quantity values are increased, i.e., moved toward the right side of tabular presentation of quantity distribution. However, most frequent

values of nanoplankton cell density and volume are similar in categories II, III and IV, ranging from 1,000,000 to 3,100,000 cells/l and 56,000,000 to 180,000,000 cu microns/l, respectively. These categories differ more from each other due to relative frequency of nanoplankton quantity being higher than characteristic limit values, as well as maximum cell density and volume values. Phytoplankton quantity being expressed by means of phytoplankton counts has significant shortcomings due to interspecific and intraspecific variations in cell size. In contrast, the combination of cell counts with volume measurements provides information not only on the composition and abundance, but also on phytoplankton biomass during standing crop studies. (Friedmann-PTT)
W89-11555

ECOLOGICAL ZONATION OF THE HYPERHALINE ESTUARY OF THE CASAMANCE RIVER (SENEGAL): FORAMINIFERA, ZOOPLANKTON AND ABIOTIC VARIABLES.
Universite du Maine, Le Mans (France). Dept. de Geologie.
J. P. Debenay, J. Pages, and P. S. Dioul.
Hydrobiologia HYDRB8, Vol. 174, No. 2, p 161-176, April 15 1989. 11 fig, 2 tab, 53 ref.

Descriptors: *Salinity, *Senegal, *Environmental gradient, *Estuarine environment, *Estuaries, *Aquatic populations, *Zooplankton, *Foraminifera, Ecosystems, Aquatic habitats, Species diversity, Population dynamics, Arid zone, Aquatic environment, Fish.

Due to a long-lasting drought afflicting the Sahel, the Casamance River has been transformed into a hyperhaline estuary, with salinities up to 170 ppt at a distance of 210 km from the sea. Foraminifera and zooplankton populations both show a marked decrease in the number of species in increasingly confined water, the distribution of species being closely related to the evolution of abiotic variables. A three-pronged study allowed identification of six zones, upwards from the sea. The uppermost ones are characterized by drastic conditions that considerably reduce the number of species. Therefore, the populations of Foraminifera, zooplankton and even fish become oligo or mono specific. The Casamance River appears to fit quite well into the general rules concerning hyperhaline environments. However, it shows some peculiar features: the large dimensions of the hyperhaline estuary (over 230 km long and over 5 km wide in the lower course); peak salinities among the highest known for a permanently open estuary (up to 170 ppt); and water remaining trapped inside the river for several years. (Author's abstract)
W89-11558

SPATIAL AND TEMPORAL TRENDS OF DIATOM FLUX IN BRITISH COLUMBIAN FJORDS.
Lamont-Doherty Geological Observatory, Palisades, NY.
C. Sancetta.
Journal of Plankton Research JPLRD9, Vol. 11, No. 3, p 503-520, May 1989. 9 fig, 21 ref. NSF Grant OCE 85-16169.

Descriptors: *Population dynamics, *British Columbia, *Diatoms, *Fjords, Spatial distribution, Temporal distribution, Biomass, Ecosystems, Succession, Seasonal variation, Phytoplankton, Density stratification, Aquatic populations, Species diversity.

The monthly flux of diatom taxa at four sites in two fjords of British Columbia, Canada, was determined over a 3-yr period by particle interceptor traps. Saanich Inlet is a small basin with little horizontal density gradient while Jervis Inlet experiences seasonal runoff and strong vertical stratification. The basic pattern of seasonal succession is the same in both fjords, but the timing and volume of production differ. Production is spread over a longer part of the year in Saanich Inlet, resulting in a more diverse assemblage, while in Jervis Inlet there is a single production maximum in May, dominated by Skeletonema costatum. Most taxa occur simultaneously at all sites, but many show a preference for one fjord, or one area within a fjord. Several species of Chaetoceros recur consistently in inner Saanich Inlet each fall, suggesting reseeding by benthic spores. In contrast, Rhizosolenia setigera is more common in the outer reaches of both fjords, and is probably introduced from outside. In Saanich Inlet, interannual variability is relatively low, except for the fall season, which may differ from year to year in both volume and taxonomic composition. Jervis Inlet is both spatially and temporally more variable: spring production may differ from year to year by an order of magnitude. In this fjord, the degree of stratification, controlled by freshwater influx, appears to determine the timing and composition of the phytoplankton assemblage. Large volumes of runoff may suppress the spring bloom, and prolonged stratification through the summer produces an unusual assemblage that may be light limited. El Nino of 1986-1987 had an opposite effect in the two fjords. In Saanich Inlet, the unusual degree of sunshine during fall resulted in the largest bloom of the entire interval. Unusually warm air temperatures prevented the build-up of winter snow around Jervis Inlet. As a result, the normal late-spring stabilization of the water column from snowmelt did not occur, and the spring bloom was eliminated. (Author's abstract)
W89-11560

LINEAR MODEL OF EXTERNAL INTERACTIONS DURING UPTAKE OF DIFFERENT FORMS OF INORGANIC NITROGEN BY MICROALGAE,
Centre de Recherche en Ecologie Marine et Aquaculture, Nieul sur Mer (France).
Y. Collos.
Journal of Plankton Research JPLRD9, Vol. 11, No. 3, p 521-533, May 1989. 7 fig, 5 tab, 46 ref.

Descriptors: *Marine environment, *Model studies, *Cycling nutrients, *Algae, *Nitrogen, Absorption, Biomass, Ecosystems, Aquatic plants, Aquatic environment, Nitrates, Nitrification, Enzymes, Model testing, Inhibition.

A simple model is developed to deal with external interactions during uptake of two inorganic nitrogen sources supplied simultaneously to microalgae. The model is based on classical competitive enzyme inhibition kinetics and involves three variables: the external concentrations of the two nitrogen compounds and an index of algal biomass. To test the model, examples taken from the literature had to meet the following criteria: (1) there are only two N sources available for each uptake; (2) there are no transformations of one source into another (nitrification, denitrification, etc.); (3) batch mode perturbation only, i.e. net changes = gross changes in nutrients; (4) time series of concentrations of N compounds and biomass index, or, for short-term experiments, data on both uptake rates and initial concentrations of N compounds. The applicability of such a simple model to examples taken in the literature indicates that complex phenomena such as feedback inhibition may not always need to be taken into account and that uptake is sometimes regulated solely by the three above variables. The model can be considered as a useful compromise between data acquisition effort and resulting predictive power, because it uses only environmental variables such as biomass or nutrients that are easily measured. The model was very useful in situations where the dependent variable correlated with no single environmental factors, but only with a combination of these. Such was the case for nitrate uptake by Gonyaulax polyedra. The model can explain not only the apparent inhibition of nitrate uptake by ammonium in many cases, but also the 'inhibition' of ammonium uptake by nitrate, a phenomenon for which no physiological explanation has so far been offered. (Friedmann-PTT)
W89-11561

BACTERIAL BIOMASS AND PRODUCTION IN SHALLOW BAY.
Pontificia Univ. Catolica de Chile, Talcahuano. Area de Biologia y Tecnologia del Mar.
S. Pantoja, H. Gonzalez, and P. A. Bernal.
Journal of Plankton Research JPLRD9, Vol. 11, No. 3, p 599-604, May 1989. 3 fig, 10 ref.

Descriptors: *Biomass, *Secondary productivity, *Bays, *Marine environment, *Estuaries, Bacterial analysis, Upwelling, Bacteria, Population dynamics, Productivity, Ecosystems, Heterotrophic bacteria, Industrial wastewater, Chile.

Bacterial biomass (BB, acridine orange) and bacterial secondary production (BSP, (3H)thymidine incubations) were measured for the first time in Concepcion Bay, Chile (37 degrees, 35 minutes S, 73 degrees, 1 min. W). In this highly productive bay, upwelling equatorial subsurface waters cause a surplus of organic production that could support high heterotrophic bacterial activity, for which neither biomass nor production estimates exist in the literature. BB ranged from 1,800,000 to 22,500,000 cells/ml (the latter value observed near an industrial effluent), BSP from 270,000 to 2,500,000 cells/day and heterotrophic turnover rates between 0.15 and 1.0 doublings/day. (Friedmann-PTT)
W89-11563

VEGETATION PATTERNS IN JAMES BAY COASTAL MARSHES: II. PHYSIOLOGICAL ADAPTATION TO SALT-INDUCED WATER STRESS IN THREE HALOPHYTIC GRAMINOIDS.
McMaster Univ., Hamilton (Ontario). Dept. of Biology.
K. Ewing, J. C. Earle, B. Piccinin, and K. A. Kershaw.
Canadian Journal of Botany CJBOAW, Vol. 67, No. 2, p 521-528, February 1989. 4 fig, 1 tab, 45 ref.

Descriptors: *Salt tolerance, *Soil-water-plant relationships, *Wetlands, *Plant physiology, *Adaptation, *Water stress, *Halophytes, *Marsh plants, *Coastal marshes, Distribution patterns, Aquatic plants, Biomass, Metabolism, Bioaccumulation, James Bay, Amino acids, Osmosis, Salt balance, Salinity, Saline soils.

The responses of three halophytes to an incremental increase in soil-water salinity have been studied under greenhouse conditions. Biomass accumulation of both the roots and shoots of each species decreased markedly as osmotic stress increased. Differences in salt sensitivity accounted for the species natural separation along a salinity gradient identified from the low marsh to the high marsh. The three species utilized different strategies to metabolically lower their internal osmotic potential during salt stress. Puccinellia phryganodes reduced cell water content and accumulated high concentrations of proline. Carex paleacea exhibited no adjustment in water retention, but accumulated high concentrations of glycine betaine and a small amount of proline. The most salt-sensitive species, Scirpus americanus, reduced cell water content while it accumulated high concentrations of glycine betaine. The reliance on proline as an osmoregulant in P. phryganodes is suggested to be an adaptation to its highly fluctuating salinity regime. There is no definitive evidence that suggests that any of the species accumulate carbohydrates in response to saline stress. The loss of reducing sugars in C. paleacea and S. americanus grown under moderately saline conditions (i.e., 5 and 10 ppt) may be attributed to a significant reduction in the photosynthetic capacity of the species. The subsequent increase in carbohydrates at higher salinities may have been due to their accumulation during severe osmotic stress. (Author's abstract)
W89-11565

PARTITION OF TRACE METALS BETWEEN DISSOLVED AND PARTICULATE PHASES IN EUROPEAN COASTAL WATERS: A COMPILATION OF FIELD DATA AND COMPARISON WITH LABORATORY STUDIES,
Marine Lab., Aberdeen (Scotland).
For primary bibliographic entry see Field 5A.
W89-11568

SULFUR SPECIATION IN SOME CHESAPEAKE BAY TIDAL MARSH SOILS.
Maryland Univ., College Park. Dept. of Agronomy.
For primary bibliographic entry see Field 2G.
W89-11576

BIOLOGICAL SURVEY ON THE BRACKISH TIDAL FLATS OF SINOERI (NAMYANG) AND THE NAGDONG RIVER ESTUARY, KOREA.
Tohoku Univ., Sendai (Japan). Biological Inst.
E. Kikuchi, T. Suzuki, S. Takeda, J. H. Kim, and K. J. Cho.
Bulletin of the Marine Biology Station at Asamushi, Tohoku University, Vol. 18, No. 3, p 109-128, March 1989. 7 fig, 6 tab, 16 ref, 2 append. Grants-in-Aid Nos. 62041008 and 63043007 for Overseas Research from the Japanese Ministry of Education, Science and Culture.

Descriptors: *Brackish water, *Ecosystems, *Environmental effects, *Korea, *Estuarine environment, *Tidal flats, *Tidal range, Zones, Benthic flora, Benthic fauna, Carbon, Nitrogen, Oxidation-reduction potential, Sandbars, Streams, Bulrushes, Plant populations, Plant growth, Biomass, Phosphorus, Calcium, Magnesium, Nutrient removal, Eutrophication, Surveys, Water quality management.

Ecological surveys on brackish tidal flats were carried out at the Sinoeri, Namyang, and Ogryudeung sandbars in the Nagdong River estuary, Korea, in September to October 1987. At the Sinoeri tidal flat with its large tidal range, a conspicuous zonation of macrobenthic animals related to water content, total carbon, total nitrogen, and redox potential of the sediments was observed along the slope from creek bottom to mound top. On the other hand, at the Ogryudeung tidal flat having a small tidal range, the noticeable zonation of macrobenthic animals was reflected in the presence of emergent plants such as Phragmites australis and Scirpus maritimus. The density, height, biomass, and nitrogen, phosphorus, calcium, and magnesium contents of Phragmites australis and Scirpus maritimus were estimated in the lower reaches of the Nagdong River. The above-ground biomass of the reed marsh ranged from 730 to 2100 grams per square meter and those of the Scirpus marsh from 117 to 205 grams per square meter. From the areal extent of reed marsh, the above-ground reed biomass, and nutrient contents of above-ground parts of reed, it can be estimated that 59,456 kilograms of nitrogen and 5274 kilograms of phosphorus are removed per year from the Nagdong River estuary if the above-ground parts of the reed are harvested. Thus the luxuriant reed community in the Nagdong River estuary will help to reduce the accelerated eutrophication of the estuary if adequate harvesting can be done. (Author's abstract)
W89-11585

DIATOM ASSEMBLAGES ASSOCIATED WITH SEDIMENT IN OGRYUDEUNG SAND BAR OF THE NAGDONG RIVER ESTUARY, KOREA.
Tohoku Univ., Sendai (Japan). Biological Inst.
K. J. Cho, J. H. Kim, and Y. Kurihara.
Bulletin of the Marine Biology Station at Asamushi, Tohoku University, Vol. 18, No. 3, p 129-137, March 1989. 3 fig, 40 pl, 2 tab, 6 ref. Grants-in-Aid Nos. 62041008 and 63043007 for Overseas Research from the Japanese Ministry of Education, Science and Culture.

Descriptors: *Korea, *Marine sediments, *Diatoms, *Sandbars, *Estuarine environment, *Species composition, *Mud flats, Sediment distribution, Physicochemical properties, Biomass, Benthos, Organic matter, Distribution patterns, Topography, Chlorophyll a, Silt, Clays, Mud, Sand, Tidal currents, Algae.

A study was made to investigate the biomass and species composition of benthic diatoms at the Ogryudeung sandbar, one of four sandbars at the lower part of the Nagdong River estuary. Diatoms on or in superficial sediment were collected along a transect line with various topographical features on the intertidal mudflat on 4 October 1987. Physicochemical conditions of the superficial sediment were examined at the same time. Organic matter showed distribution patterns according to the relative height of the sampling sites; overall physicochemical factors of the samples were closely related to topographic features and sediment texture. Total chlorophyll a and pheopigment were both higher in silt-clay rich sediments, suggesting that the muddy habitat may be more stable than the sandy habitat; sediment and diatoms in the lower sampling sites may be washed out by tidal currents. The diatoms from eight sediment samples were separated into 92 taxa. Nine species had over 2.5% relative abundance, and accounted for 62% of sampled diatoms. Diatom assemblages were divided into epipelic and epipsammic associations. The algal standing crops at eight sampling sites showed a definite variation along with topographical features and sediment texture. (Author's abstract)
W89-11586

FORMATION PROCESSES OF LACUSTRINE DELTA--AN EXAMPLE FROM ECHI RIVER DELTA, LAKE BIWA--1. RECENT SEDIMENTARY ENVIRONMENTS.
Geological Survey of Japan, Tsukuba. Environmental Geology Dept.
For primary bibliographic entry see Field 2J.
W89-11614

REPRODUCTIVE IMPAIRMENT IN A FISH INHABITING A CONTAMINATED COASTAL ENVIRONMENT OFF SOUTHERN CALIFORNIA.
Occidental Coll., Los Angeles, CA. Dept. of Biology.
For primary bibliographic entry see Field 5C.
W89-11649

PHOSPHORUS DYNAMICS ASSOCIATED WITH PHYTOPLANKTON BLOOMS IN EUTROPHIC MIKAWA BAY, JAPAN.
Nagoya Univ. (Japan). Water Research Inst.
M. Sakamoto, and T. Tanaka.
Marine Biology MBIOAJ, Vol. 101, No. 2, p 265-271, April 1989. 6 fig, 34 ref.

Descriptors: *Bays, *Japan, *Cycling nutrients, *Phosphorus, *Phytoplankton, *Eutrophication, *Particulate matter, *Cycling nutrients, Ecosystems, Growth rates, Aquatic environment, Aquatic plants, Fluctuations, Biochemistry, Red tide.

Changes in the phosphorus components of the particulate matter in seawater were studied in the eutrophic waters of Mikawa Bay, Japan, during summer 1981. The particulate phosphorus content displayed remarkable changes associated with phytoplankton blooms caused by wind-induced or upwelling-associated nutrient enrichment from the bottom water layers. Nanoplankton < 10 microns accounted for much of the particulate phosphorus (70 to 79 percent in June and July, and 44 to 78 percent in August and September); the contribution of large-sized phytoplankton > 25 microns varied from 9 to 49 percent, the peak values being attained under red-tide conditions. The capacity for phosphorus storage in cells was low in nanoplankton cells, high in large phytoplankton species. Differences in rates of phosphorus storage and growth between nanoplankton and large phytoplankton accounted for fluctuations in particulate phosphorus that were closely associated with fluctuations in phytoplankton blooms in Mikawa Bay. (Author's abstract)
W89-11662

TOXICITY OF ORGANOTINS TOWARDS THE MARINE YEAST DEBARYOMYCES HANSENII.
Dundee Univ. (Scotland). Dept. of Biological Sciences.
For primary bibliographic entry see Field 5C.
W89-11666

DISTRIBUTION OF ICHTHYOPLANKTON IN SOUTHAMPTOM WATER IN RESPONSE TO LOW OXYGEN LEVELS PRODUCED BY A MESODINIUM RUBRUM BLOOM,
Southampton Univ. (England). Dept. of Oceanography.
G. C. Hayes, D. A. Purdie, and J. A. Williams.
Journal of Fish Biology JFIBA9, Vol. 34, No. 5, p 811-813, 1989. 2 fig, 5 ref.

Descriptors: *Red tide, *Estuaries, *Eutrophication, *Zooplankton, *Oxygen deficit, Aquatic environment, Aquatic populations, Oxygen balance, Estuaries, Temporal distribution, Ecosystems, Biomass, Population density, Juvenile growth stage, Distribution patterns, Plankton nets.

The abundance and distribution of Southampton water ichthyoplankton was determined in relation to water column oxygen levels set up during bloom conditions of Mesodinium rubrum. A zooplankton sampling program was conducted at sites throughout the estuary during the M. rubrum bloom. Oxygen saturation values were recorded at 15-s intervals, from which a 'mean oxygen level' for each tow was determined. Tows, taken at all stages of the tide, were typically of 3-5 min duration with the volume of water filtered varying from 14 to 43 cu m. Bottle samples were also taken at 1-m depth intervals to assess the vertical distribution of M. rubrum abundance immediately following each net tow. The ichthyoplankton was dominated by the family Gobiidae, and most specimens were sand gobies, Pomatoschistus minutus. No statistically significant pattern was between abundance of gobies at each depth interval sampled and oxygen levels. The study results suggest that there is no consistent active avoidance by larval and postlarval gobies of the widely varying oxygen levels between sub-oxic and supersaturated waters, although maximum abundance was higher at sub-oxic levels. (Friedmann-PTT)
W89-11675

CYCLIC ORGANOCHLORIDES IN PLANKTON FROM THE NORTH SEA IN SPRING.
Hamburg Univ. (Germany, F.R.). Inst. fuer Biochemie und Lebensmittelschemie.
For primary bibliographic entry see Field 5B.
W89-11807

DETACHED CHLOROPHYTES AS NURSERY AREAS FOR FISH IN SULAIBIKHAT BAY, KUWAIT.
Kuwait Univ., Safat. Dept. of Zoology.
For primary bibliographic entry see Field 8I.
W89-11808

DIAGENESIS OF ORGANIC MATTER IN GEORGIA SALT MARSHES.
Carnegie Institution of Washington, DC. Geophysical Lab.
M. L. Fogel, E. K. Sprague, A. P. Gize, and R. W. Frey.
Estuarine, Coastal and Shelf Science ECSSD3, Vol. 28, No. 2, p 211-230, February 1989. 9 fig, 2 tab, 47 ref.

Descriptors: *Wetlands, *Salt marshes, *Georgia, *Diagenesis, *Organic matter, *Sediments, Bacteria, Plankton, Spartina, Suspended solids, Humic acids.

Organic matter preserved in sediments of Georgia salt marshes derived from Spartina alterniflora and planktonic and bacterial substances. Sources and diagenesis of sedimentary organic material were studied by means of stable C and N isotopes and gas chromatography of pyrolysates from plants, suspended sediments, and a series of muds (modern to 1400 years old) from St. Catherines Island, Georgia. Suspended particulate matter (> 20 micom) has isotopic compositions (delta13C = -18 to -22), which are composed of an average 34-42% plankton carbon and 58-65% higher plant detritus, as determined by isotopic mass balance of the system. The delta 13C of bulk sediments and humic acids (delta 13C = -18 to -19) extracted from them remain relatively constant over time. The delta 13C of acid hydrolyses, however, changed from -15 ppm in surface marsh sediment to a delta 13C of -19 from sediment sampled at a depth of 125 cm. Higher plant normal hydrocarbons are present in

muds and in particulate matter from the water column, and delta 13C in lipids and gas chromatography of pyrolysates of samples reflect this addition. With increasing age, delta 15 of total sediments and acid hydrolysates increases, and the ratio of odd-to-even hydrocarbons in the phyrolysates decreases. Initially, low density in sediments consists primarily of plant fragments. With time, this material is decayed and diluted by microbial material, changes that are reflected by more delta 13C of -15 to -17.5, as compared to delta 13C of -12 for modern Spartina and the addition of n-alkanes in the range of C13-19. The isotopic heterogeneity in surface sediments with carbon as an example, ranged from a delta 13C of -15 (plant fragments) to -22 (sediment following lipid, humic acid, and plant fragment extraction). Nowhere was the C isotopic composition of total Spartina expressed even though microscopic plant pieces, lignocellulose pyrolysis fragments, and n-alkanes from C22-27 were detected in suspended particulate matter, total sediments, and humic acids. (Author's abstract)
W89-11809

PUGET SOUND: THE CHALLENGE OF IMPLEMENTING AN ESTUARY PROTECTION PLAN.
Puget Sound Water Quality Authority, Seattle, WA.
For primary bibliographic entry see Field 5G.
W89-11862

METHOD FOR WETLAND FUNCTIONAL ASSESSMENT. VOLUME II: FHWA ASSESSMENT METHOD,
Center for Natural Areas, South Gardiner, ME.
For primary bibliographic entry see Field 2H.
W89-11887

SHAD RETURN TO THE DELAWARE,
For primary bibliographic entry see Field 5G.
W89-11899

NEWPORT NEWS CHANNEL DEEPENING STUDY, VIRGINIA: NUMERICAL MODEL INVESTIGATION.
Army Engineer Waterways Experiment Station, Vicksburg, MS. Hydraulics Lab.
For primary bibliographic entry see Field 8B.
W89-11904

WATER QUALITY MANAGEMENT PLAN NORTH SEA: FRAMEWORK FOR ANALYSIS.
Waterloopkundig Lab. te Delft (Netherlands).
For primary bibliographic entry see Field 5G.
W89-11995

LONG-TERM SAND CAP STABILITY: NEW YORK DREDGED MATERIAL DISPOSAL SITE.
Science Applications, Inc., Newport, RI.
For primary bibliographic entry see Field 5E.
W89-12094

FJORD SEDIMENTATION IN NORTHERN BRITISH COLUMBIA.
McMaster Univ., Hamilton (Ontario). Dept. of Geography.
For primary bibliographic entry see Field 2J.
W89-12120

QUATERNARY STRATIGRAPHY OF REPRESENTATIVE MAINE ESTUARIES: INITIAL EXAMINATION BY HIGH-RESOLUTION SEISMIC REFLECTION PROFILING.
Maine Univ. at Orono. Dept. of Geological Sciences.
For primary bibliographic entry see Field 2J.
W89-12124

SEWAGE EFFECTS IN MARINE AND ESTUARINE ENVIRONMENTS, JANUARY, 1977-MARCH, 1988: CITATIONS FROM THE NTIS BIBLIOGRAPHIC DATABASE.
National Technical Information Service, Springfield, VA.
For primary bibliographic entry see Field 5C.
W89-12141

3. WATER SUPPLY AUGMENTATION AND CONSERVATION

3A. Saline Water Conversion

STUDIES ON DIISOCYANATE-MODIFIED CELLULOSE ACETATE MEMBRANES.
National Taiwan Univ., Taipei. Dept. of Chemical Engineering.
K. H. Hsieh, B. Y. Lin, and W. Y. Chiu.
Desalination DSLNAH, Vol. 71, No. 2, p 97-105, February 1989. 10 fig, 1 tab, 8 ref. National Science Council, Taiwan, grant NSC75-0405-E002-02.

Descriptors: *Limnology, *Cellulose acetate membranes, *Reverse osmosis, *Membrane processes, *Desalination, Infrared spectroscopy, Salt rejection, Strength.

This paper describes the reaction of the highly reactive -NCO group as present in diisocyanate with the basic -OH group as present in cellulose acetate in a mixture of dichloromethane and t-butyl alcohol, thereby producing minimally crosslinked cellulose acetate bearing urethane groups and consequently yielding membranes by using the Kesting dry method. The urethane group was verified through infrared spectroscopy, a reverse-osmosis testing system was used to study the transport characteristics of the membrane, and its tensile strength was also tested. The structure of the membrane pores is described. The results indicated that significant improvements were observed with respect to the salt rejection of the modified cellulose acetate membrane as well as to its tensile strength. However, these improvements were accompanied by a slight decrease in the water flux. (Author's abstract)
W89-11201

COST-EFFECTIVENESS OF SOLAR WATER PRODUCTION.
Kuwait Inst. for Scientific Research, Safat.
R. K. Suri, A. M. R. Al-Marafie, A. A. Al-Homoud, and G. P. Maheshwari.
Desalination DSLNAH, Vol. 71, No. 2, p 165-175, February 1989. 4 fig, 4 tab, 5 ref.

Descriptors: *Water treatment, *Limnology, *Desalination, *Solar energy, *Cost analysis, Reverse osmosis, Multi-stage flash technique, Costs, Electric power costs, Solar distillation, Operating costs, Energy sources, Water treatment facilities, Solar ponds, Construction costs, Thermal energy, Energy costs.

Cost analysis of water production using conventional and solar energy were made for the multi-stage flash (MSF) and reverse osmosis (RO) desalination techniques. Water production using conventional or commercial sources of energy is 26% less expensive with the RO system compared to the MSF system. The major difference is attributed to the cost of energy since the balance of system cost is nearly equal for both systems. At this time none of the solar-based technologies can compete with either of the desalination systems operating with conventional energy sources. A partially solar-powered MSF system (thermal energy from solar pond and using commercial electricity) produces water at a cost of 0.51 KD/cu m, which is the lowest cost for all solar energy-based technologies. This cost is on a par with the cost of water production for the commercial MSF system. Further reduction in the construction cost of the solar pond or increase in its energy extraction efficiency will make water production cheaper. An attempt was made to predict the conditions of economic viability for water production. The variations considered are an increase in the fuel prices, the construction cost and energy collection efficiency of the solar pond and a reduction in the cost of photovoltaic systems. The construction cost and efficiency of the solar pond were combined as the cost efficiency factor (C). This value for the present analysis is 75, given by C=(construction cost of 15 KD/sq m)/(pond efficiency of 0.2). A decrease in C due to either a reduction in construction cost or an improvement in the pond efficiency, will help to make a solar pond coupled system closer to a conventional system from the cost-effectiveness point of view. (Sand-PTT)
W89-11203

ECONOMIC ASPECTS OF LOW-TEMPERATURE MULTI-EFFECT DESALINATION PLANTS.
Patras Univ. (Greece). Dept. of Mechanical Engineering.
Y. G. Caouris, E. T. Kantsos, and N. G. Zagouras.
Desalination DSLNAH, Vol. 71, No. 2, p 177-201, February 1989. 8 fig, 2 tab, 9 ref. Append.

Descriptors: *Limnology, *Desalination plants, *Economic aspects, Cost analysis, Model studies, Greece.

The technical parameters of multi-effect low-temperature distillation plants are determined and the production cost of every input is calculated separately for the successive levels of production under various loads of annual operation, by using a computational model devised for this purpose. The results lead to the development of the respective production map diagrams. Observation of the iso-cost and iso-product curves in these diagrams allows the determination of the optimal number of effects for each combination of production level and annual operation load. The sensitivity of the optimal number of effects relatively to the price system is also examined. The average total cost is formulated as a function of the size of the plant under full load operation. The cost is also formulated as a function of the annual operation load for each plant size. The work is relevant to the design of desalanation plants on Greek islands and other arid zones of the littoral countryside. (Author's abstract)
W89-11204

DETERMINATION OF SEAWATER ENTHALPY AND ENTROPY DURING THE CALCULATION OF THERMAL DESALINATION PLANTS.
Dal'nevostochnyi Politekhnicheskii Inst., Vladivostok (USSR).
For primary bibliographic entry see Field 1A.
W89-11205

3B. Water Yield Improvement

BRUSHLAND MANAGEMENT FOR INCREASED WATER YIELD IN TEXAS.
Texas A and M Univ., College Station. Dept. of Agricultural Economics.
R. C. Griffin, and B. A. McCarl.
Water Resources Bulletin WARBAQ, Vol. 25, No. 1, p 175-186, February 1989. 1 fig, 4 tab, 42 ref.

Descriptors: *Water yield improvement, *Water scarcity, *Texas, *Brush management, *Range management, *Water policy, Economic aspects.

Policies to encourage brush management are under consideration as a means to address the water scarcity issue in Texas. Additional water can be generated by treating some of the 100-million-plus acres of brush-infested rangelands in Texas primarily by replacing brush with grasses. Evidence of water yield benefits are, however, tentative. Economic investigations based on available data show the potential desirability of brush management but also show benefits to be critically dependent on added water yield, value, and cost-sharing policy. Wildlife, water rights, and environmental issues are also important considerations. The lack of research information on likely impacts makes it difficult to choose among alternative policies for encouraging brush management. More research on this potential opportunity is needed. (Author's abstract)
W89-11174

DIAGNOSIS OF SEVENTY MUNICIPAL WATER SUPPLY BOREHOLES IN LIMA, PERU.
Binnie and Partners, Redhill (England).
S. Puri, J. L. Petrie, and C. V. Flores.
Journal of Hydrology JHYDA7, Vol. 106, No. 3/4, p 287-309, April 20 1989. 12 fig, 5 tab, 16 ref.

Descriptors: *Water yield improvement, *Municipal water, *Peru, *Boreholes, *Water table decline, *Groundwater management, *Rehabilitation, Water demand, Water supply, Aquifers, Aquifer management, Water table, Water level fluctuations, Geohydrology, Pumping tests, Well data, Well screens, Well yield, Borehole geophysics.

Borehole diagnoses were carried out in the wake of declining yields and falling water table in the Lima aquifer. The objective was to evaluate, from a representative sample, the rehabilitation that would be required to restore yields and supply increasing demands. Rehabilitation methods are well described in the literature; however, the selection and evaluation of techniques, appropriate in a given hydrogeological context, are not well known. The current status of the Lima aquifer and the investigations performed in selecting appropriate rehabilitation were based on comprehensive diagnosis in 70 boreholes. Seven items of field tests were carried out on each borehole, including pumping tests, downhole closed-circuit TV (CCTV) survey, detailed hydrochemical analyses of hydrogeological and electrical-mechanical data. Overdevelopment of the aquifer has resulted in static water level decline which in turn has had serious consequences in reducing the amount of hydraulically active screens. Screens originally below the pumping water level are now above the present-day static level. Ongoing rehabilitation, formulated to sustain future supplies, and aimed at reducing well losses, increasing the length of water column in the borehole, and improving the operating efficiency of pumps was the main recommendation. Four categories of rehabilitation were considered appropriate to the diagnosed boreholes: basic renovation and maintenance; redevelopment by physical and chemical means; major repairs of existing pumps, pipework and screens; and major works, including borehole deepening by 50 m, installation of new well screens to exploit lower aquifers and new pumps. Yield improvement by 56 percent and increase of the useful life of boreholes by 10 years has been projected from the diagnosis. The program of rehabilitation is to be implemented. (Author's abstract)
W89-11681

WINTER CLOUD SEEDING POTENTIAL ON THE MOGOLLON RIM.
Bureau of Reclamation, Denver, CO. Div. of Research and Lab. Services.
A. B. Super, E. W. Holroyd, and J. T. McPartland.
Available from the National Technical Information Service, Springfield, VA 22161. Final Report No. R-89-02, January 1989. 173p, 34 fig, 16 tab, 36 ref, append. Bureau of Reclamation Contract IGA-88-6189-000-0051.

Descriptors: *Cloud seeding, *Artificial precipitation, *Weather modification, *Arizona, Mogollon Rim, Cloud liquid water, Cloud physics, Snow, Precipitation, Orography, Nucleation.

Natural cloud and precipitation processes were investigated on the Mogollon Rim of Arizona during mid-January to mid-March of 1987 and 1988. The primary goal was to evaluate the cloud seeding potential of winter storms prior to attempting any seeding. It was crucial to monitor the availability of supercooled CLW (cloud liquid water) required for precipitation development, and this was accomplished with a ground-based microwave radiometer and instrumented aircraft. Other measurements of importance included cloud depth and structure, atmospheric stability, winds, cloud ice particles and water droplets, and surface precipitation. The field measurements were put in the context of large-scale weather patterns using standard weather maps and satellite photographs. A secondary goal involved evaluation of ground-based seeding simulated by transport and diffusion experiments using a tracer gas. Several important findings emerged from the various analyses of the data. Cloud liquid water was available during portions of most storm episodes. The flux of liquid water passing over the crestline during a 4-month winter was estimated at 30% to 100% of the mean annual runoff from the study areas. Thus, the raw material required for successful cloud seeding was available in reasonable abundance. The majority of the total CLW flux for each season was produced during a few large storms that were efficient in producing snowfall during portions of their lifetimes but quite inefficient during other periods. The total flux for both seasons was approximately equally divided between 326 hrs with vertically integrated CLW amounts < 0.20 mm and 59 hours with amounts between 0.20 and 0.65 mm. The amount of CLW produced by local storms or isolated clouds was limited. The transport and diffusion studies revealed that plumes of ground-based seeding material could usually fill most of the lowest kilometer of cloudy air passing over the crest during periods with stratiform clouds. However, this zone was often too warm for significant ice nucleation with conventional types of silver iodide and generators. Aircraft seeding would likely be required for a large fraction of the Arizona storm clouds. (Author's abstract)
W89-12090

3C. Use Of Water Of Impaired Quality

ASSESSMENT OF STORMWATER RUNOFF FOR RECYCLE IN COOLING TOWERS AT KSC, FLORIDA.
Florida Inst. of Tech., Melbourne. Dept. of Chemical Engineering.
For primary bibliographic entry see Field 3D.
W89-11159

CHANGES IN GAS EXCHANGE CHARACTERISTICS AND WATER USE EFFICIENCY OF MANGROVES IN RESPONSE TO SALINITY AND VAPOUR PRESSURE DEFICIT.
Australian Inst. of Marine Sciences, Townsville.
For primary bibliographic entry see Field 2I.
W89-11199

COMPATIBLE ORGANIC SOLUTES AND SALT TOLERANCE IN SEEDLINGS OF THREE ANNUAL MEDICAGO SPECIES (SOLUTES ORGANIQUES COMPATIBLES ET TOLERANCE AU CHLORURE DE SODIUM CHEZ LES JEUNES PLANTES DE TROIS ESPECES ANNUELLES DU GENRE MEDICAGO).
Universite des Sciences et de la Technologie Houari Boumediene, Algiers (Algeria). Inst. de Biologie.
A. Refoufi, and F. Larher.
Comptes Rendus de l'Academie des Sciences (Series 3) Sciences de la Vie CRAMED, Vol. 308, No. 12, p 329-335, March 1989. 3 fig, 18 ref. English summary.

Descriptors: *Salt tolerance, *Organic compounds, *Salinity, *Seedlings, Stress, Biomass, Solutes, Sodium, Potassium, Salts.

Salt treatments at concentrations ranging from 0 to 300 millimoles were applied for 48 or 96 hr to seedlings of Medicago scutellata, M. truncatula and M. polymorpha and biomass production, sodium, potassium, free proline and total methylated onium compounds (MOC) contents were determined. The MOCs choline, stachydrine and trigonelline were found to be accumulated in dry seeds of all three species at levels between 50 and 100 micromoles/g. Salt tolerance of seedlings was much higher in M. scutellata. This was attributed to a lower level of sodium accumulation and to the ability of the Medicago species to maintain a high internal potassium level. The total MOC contents were not modified in response to salt shocks while those for free proline were drastically enhanced. The most tolerant species M. scutellata also exhibited the highest potential for proline accumulation. In annual Medicago species, the internal K(+)/Na(+) ratio and the magnitude of the proline response might be relevant traits for screening seedlings for salt shock tolerance. (Geiger-PTT)
W89-11398

REARING OF GRASS CARP LARVAE (CTENOPHARYNGODON IDELLA VAL.) IN PONDS RECEIVING HEATED EFFLUENTS: I. SCHEME OF THE EXPERIMENT, TEMPERATURE, WATER FLOW IN THE PONDS AND FISH PRODUCTION (PODCHOW WYLEGU AMURA BIALEGO (CTENOPHARYNGODON IDELLA VAL.) W STAWACH ZASILANYCH WODA PODGRZANA: I. SCHEMAT EKSPERYMENTU, TEMPERATURA I PRZEPLYW WODY W STAWACH ORAZ WYNIKI RYBACKIE).
Instytut Rybactwa Srodladowego, Olsztyn-Kortowo (Poland).
For primary bibliographic entry see Field 8I.
W89-11497

REARING OF GRASS CARP LARVAE (CTENOPHARYNGODON IDELLA VAL.) IN PONDS RECEIVING HEATED EFFLUENTS: II. PHYSICO-CHEMICAL CONDITIONS (PODCHOW WYLEGU AMURA BIALEGO (CTENOPHARYNGODON IDELLA VAL.) W STAWACH ZASILANYCH WODA PODGRZANA: II. WARUNKI FIZYCZNO-CHEMICZNE).
Instytut Rybactwa Srodladowego, Olsztyn-Kortowo (Poland).
For primary bibliographic entry see Field 8I.
W89-11498

REARING OF GRASS CARP LARVAE (CTENOPHARYNGODON IDELLA VAL.) IN PONDS RECEIVING HEATED EFFLUENTS: III. FOOD CONDITIONS (PODCHOW WYLEGU AMURA BIALEGO (CTENOPHARYNGODON IDELLA VAL.) W STAWACH ZASILANYCH WODA PODGRZANA: III. WARUNKI POKARMOWE).
Instytut Rybactwa Srodladowego, Olsztyn-Kortowo (Poland).
J. Wolnicki, and K. Opuszynski.
Roczniki Nauk Rolniczych, Seria H: Rybactwo RNRRB9, Vol. 101, No. 4, p 149-159, 1988. 4 fig, 1 tab, 24 ref. English summary.

Descriptors: *Fish management, *Carp, *Heated water, *Temperature effects, *Fish food, Fish, Growth stages, Larval growth stage, Fish ponds, Biomass, Zooplankton, Plankton, Aquatic animals, Benthos, Fauna, Physiological ecology, Fertilization.

Studies were carried out on the food conditions for grass carp larvae in six ponds in Poland fed with heated effluents from a power plant. Average numbers of the zooplankton were high (1120-2556 indiv/l), at similar taxonomic composition. Copepod nauplii and Daphnia cucullata were most numerous. Changes in the zooplankton numbers and biomass were also similar in all ponds. Average numbers and biomass were lower in the ponds with water flow and intensive organic fertilization. Zooplankton numbers in the inflow channel were a few times lower than in the ponds. Biomass of the zooplankton was predominated by Cladocera, especially in the ponds with intensive fertilization. Bottom fauna was scarce in all ponds, but most abundant in the ponds with intensive fertilization. It was predominated by small species, such as Polypedilum nubeculosum and Cricotopus silvestris, and Tanyatarsus gregarius in ponds with water flow. Food conditions for grass carp larvae were good in all ponds irrespective of the fertilization and inflow of heated water, this being especially so in case of the zooplankton. Intensive organic fertilization was considered as beneficial for development of the bottom fauna. (See W89-11497 thru W89-11498 and W89-11500) (Author's abstract)
W89-11499

REARING OF GRASS CARP LARVAE (CTENOPHARYNGODON IDELLA VAL.) IN PONDS RECEIVING HEATED EFFLUENTS: IV. FOOD (PODCHOW WYLEGU AMURA BIALEGO (CTENOPHARYNGODON IDELLA VAL.) W

STAWACH ZASILANYCH WODA PODGRZANA: IV. POKARM).
Instytut Rybactwa Srodladowego, Olsztyn-Kortowo (Poland).
G. Okoniewska, and K. Opuszynski.
Roczniki Nauk Rolniczych, Seria H: Rybactwo RNRRB9, Vol. 101, No. 4, p 161-175, 1988. 5 fig, 30 ref. English summary.

Descriptors: *Fish management, *Carp, *Fertilization, *Fish food, *Heated water, Fish, Growth, Growth stages, Larval growth stage, Behavior, Powerplants, Temperature effects, Crustaceans, Copepods, Rotifers, Aquatic animals, Flow, Midges.

Feeding behavior of grass carp larvae was studied in six ponds fed with heated effluents from a power plant in Poland, with different water flow rate. The ponds were stocked on 21 June 1980 with 3-day larvae of grass carp, at a rate of 750,000 indiv/ha. Water flow increased the temperature by 2 C on the average, this being reflected in the food conditions and fish feeding behavior. In ponds with lower temperature, the growth rate was slower, and final weight of the fishes was 5 times lower than in the ponds with higher temperature. Fish food in the ponds with no water flow consisted mainly of Copepoda nauplii and copepodits. In the food tracts of the larvae from the ponds with water flow, a succession of the food organisms was observed as follows: rotifers, nauplii, copepodits, Cladocera, Chironomidae larvae. Predomination and size of the consumed organisms depended on the fish growth rate. Food selectivity of the grass carp larvae was assessed with Ivlev's index. Considerable variability of the indices was observed as regards particular groups of the plankton, determined by the fish weight. In the first period, the larvae selected the rotifers Copepoda nauplii; later on, the copepodits. The selectivity index did not reveal any preference toward Cladocera by grass carp larvae during 21 days of rearing. (See W89-11497 thru W89-11499) (Author's abstract)
W89-11500

RESPONSE OF WHITE CLOVER (TRIFOLIUM REPENS L.) AND RYEGRASS (LOLIUM PERENNE L.) TO ACID RAIN IN SITUATIONS OF SPECIES INTERFERENCES.
Institute of Terrestrial Ecology, Bangor (Wales). Bangor Research Station.
For primary bibliographic entry see Field 5C.
W89-11527

MODELING HEALTH RISKS ASSOCIATED WITH WASTEWATER REUSE AS IRRIGANT.
Yarmouk Univ., Irbid (Jordan).
A. B. M. Shahalam, and A. R. Mansour.
Journal of Environmental Science and Health (A) JESEDU, Vol. 24A, No. 2, p 147-166, February 1989. 3 fig, 3 tab, 9 ref.

Descriptors: *Public health, *Risk assessment, *Water reuse, *Wastewater irrigation, *Impaired water use, *Irrigation water, *Pathogens, *Wastewater treatment, *Model studies, Activated sludge, Sewer systems, Detention time, Temperature, Wastewater collection, Wastewater lagoons, Land disposal.

A systematic approach to determine the reduction of pathogenecity of wastewater through its transport from households to agricultural lands is outlined. The initial pathogen concentration in wastewater is highly variable and depends on factors such as geographical location of the wastewater and health standards of the people and institutions generating the wastewater. A probabilistic model has been developed which combines the effect of different stages of wastewater transportation on its pathogenecity and predicts the expected level of pathogens at the application stage of the wastewater. The principal stages of wastewater pathogen existence are: (1) collection; (2) treatment; (3) transportation through conduits or forced mains; (4) storage in lagoons or tanks; and (5) application. Once wastewater is applied on crop land, pathogens may remain attached to soil or crops. After eliminating temperature and hydraulic detention time effects, an activated sludge process appeared to be the most attractive wastewater treatment process for eliminating some of the pathogens. Further information indicated that adding the appropriate detention time following an activated sludge process resulted in a wastewater effluent comparable to a lagoon effluent that could be achieved economically. (White-Reimer-PTT)
W89-11641

LONG-TERM CONTRACTS FOR LARGE USERS: AN INDUSTRY VIEWPOINT.
General Motors Corp., Detroit, MI.
For primary bibliographic entry see Field 5F.
W89-11737

3D. Conservation In Domestic and Municipal Use

ASSESSMENT OF STORMWATER RUNOFF FOR RECYCLE IN COOLING TOWERS AT KSC, FLORIDA.
Florida Inst. of Tech., Melbourne. Dept. of Chemical Engineering.
F. E. Dierberg, and K. L. Jones.
Water Resources Bulletin WARBAQ, Vol. 25, No. 1, p 43-47, February 1989. 2 fig, 3 tab, 9 ref.

Descriptors: *Storm water, *Storm runoff, *Rainfall harvesting, *Cooling water, *Cooling towers, Kennedy Space Center, Florida, Air conditioning, Water conservation.

In addition to measuring the quantity of stormwater runoff generated during 10 rainfall events from the Vehicle Assembly Building (VAB) area of Kennedy Space Center, historical rainfall records were also used for determining the feasibility of implementing a program of stormwater recycling to air conditioning cooling towers. It was projected that 0.182 million gallons per day (MGD) of runoff would be generated from the VAB area during a year of average rainfall (48 inches); only 0.117 MGD is required for coolant makeup water in the VAB area. Due to the seasonal variations in rainfall, stormwater recycling may not always meet all the cooling water demands. (Author's abstract)
W89-11159

WELFARE EFFECTS OF ALTERNATIVE WATER RATIONING SCHEMES: A CASE STUDY.
California Univ., Santa Barbara. Dept. of Economics.
For primary bibliographic entry see Field 6C.
W89-11177

RESERVOIR OVERCOMES LEAK LOSSES.
Cincinnati Water Works, OH.
For primary bibliographic entry see Field 4A.
W89-11631

OVERALL EFFECT ON ANNUAL COSTS OF A REDUCTION IN WATER USE WITH SEPARATE METERING OF FLATS IN PRETORIA.
Water Research Commission, Pretoria (South Africa).
J. P. Kriel.
Water SA WASADV, Vol. 15, No. 2, p 111-126, April 1989. 3 fig, 8 tab, 7 ref.

Descriptors: *Water use, *Water costs, *Water demand, *Economic aspects, *Water metering, Separated meters, South Africa, Capital, Cost analysis, Apartment blocks.

An investigation involving two identical blocks of 60 flats each in Pretoria (South Africa) indicated that individual metering of flats in Pretoria results in a saving of 25% in water use compared to that for a block of flats with a single bulk meter. Based on the unit costs of 1986, it was concluded that the cost of water supply would be increased by about 8% for consumers in the block. This estimate did not, however, take into account the effect of a reduction in demand on capital expenditure and on the associated annual capital charges. A separate study of the water supply and the expenditure thereon showed that, in the long run, despite substantial annual deviations, there exists a relatively firm relationship between the cumulative capital expenditure and the annual volume of the water supply. This confirms that logical conclusion that a reduction in water demand or in the growth rate thereof will eventually lead to a relative reduction in capital expenditure and ultimately to a relative reduction in the annual capital charges for water supply. Although the reduced demand will initially lead to increased unit costs for water, this effect will be eliminated with a resumption or continuation in the growth of the supply, probably within 2 yr. A comparison of costs is complicated by the effects of inflation, increased cost for developing new water supplies, and annual variations in the rate of growth in water demand. However, the study shows that there will be an economic advantage in reducing the consumption of water. It is concluded that if the effect on capital expenditure of the reduction in water use by individually metering the hypothetical block of 60 flats is considered, it will not increase the costs of water supply by 8%, but will after few years result in a cost reduction of about 20%. Although these percentages only apply to the Pretoria case, it is believed that the trend will be widely applicable. (Author's abstract)
W89-11747

ADDITION OF A CLIMATE VARIABLE TO THE HOWE AND LINAWEAVER WESTERN SPRINKLING EQUATION.
Wilson (Lee) and Associates, Inc., Santa Fe, NM.
L. Wilson.
Water Resources Research WRERAO, Vol. 25, No. 6, p 1067-1069, June 1989. 1 tab, 7 ref.

Descriptors: *United States, *Forecasting, *Water demand, *Climates, Sprinkler irrigation, Domestic water, Mathematical equations, Pricing, Economic aspects, Moisture deficiency, Regression analysis.

The equation published by Howe and Linaweaver in 1967 for predicting residential sprinkling demand in metered communities of the western United States is used extensively in forecasting despite its lack of a climatic variable. Reanalysis of the original data produced a different equation, in which climate is the single most important predictor of summer metered sprinkling demand in the west (i.e., west of the 96th meridian). The new equation indicates elasticities as follows: price, -0.5, home value, +0.6, and moisture deficit, +1.3. Prediction of average summer sprinkling demand (gallons/day/dwelling unit) with the new equation for 12 locations yielded an average error of 14.6%, far less than the error of 41.0%, which was obtained when Howe and Linaweaver's 'equation of best fit' was employed. (Rochester-PTT)
W89-11750

3E. Conservation In Industry

EVALUATION OF INDUSTRIAL COOLING SYSTEMS USING RECLAIMED MUNICIPAL WASTEWATER.
California State Water Resources Control Board, Sacramento.
For primary bibliographic entry see Field 5D.
W89-11234

RECOVERY AND RECYCLING OF LIQUID EFFLUENT AT GNFC-A STEP TOWARDS ZERO EFFLUENT.
Gujarat Narmada Valley Fertilizers Co. Ltd., Broach (India).
For primary bibliographic entry see Field 5G.
W89-11235

REGIONALIZATION IN WATER SUPPLY INDUSTRY: STATUS AND NEEDS.
Colorado State Univ., Fort Collins.
For primary bibliographic entry see Field 6B.
W89-11602

AUTOMATED PRETREATMENT OF ELECTROPLATING WASTE AT TINKER AFB, OK.
Oklahoma City Air Logistics Center, Tinker AFB, OK.
For primary bibliographic entry see Field 5D.
W89-12018

WASTE MINIMIZATION AUDIT MANUAL FOR THE PRINTED CIRCUIT BOARD INDUSTRY.
PRC Environmental Management, Inc., San Francisco, CA.
For primary bibliographic entry see Field 5D.
W89-12019

3F. Conservation In Agriculture

WESTERN IRRIGATION RESPONSE TO PUMPING COSTS: A WATER DEMAND ANALYSIS USING CLIMATIC REGIONS.
Economic Research Service, Washington, DC.
For primary bibliographic entry see Field 6D.
W89-11247

PHYSIOLOGICAL ROUTE TO INCREASED WATER USE EFFICIENCY IN ALFALFA,
New Mexico State Univ., Las Cruces. Dept. of Biology.
V. P. Gutschick, and G. L. Cunningham.
Available from National Technical Information Service, Springfield, VA 22161 as PB89-182638/AS, price codes: A03 in paper copy, A01 in microfiche. New Mexico Water Resources Research Institute, Las Cruces, Technical Completion Report No. 239, February 1989. 37p, 3 fig, 2 tab, 72 ref, append. USGS Contract no. 14-08-0001-G1438. State Project no. 1423693.

Descriptors: *Water use efficiency, *Irrigation requirements, *Alfalfa, *Crop yield, Plant physiology, Photosynthesis, New Mexico, Leaf mass, Forages.

Alfalfa is the top-ranked cash crop in New Mexico and the most copious user of irrigation water. The water usage/mass of forage yield might be reduced, that is, the water use efficiency (WUE) might be increased, because it is under some measure of physiological control. Working from a knowledge of biophysics and plant physiology, it is proposed that WUE and yield are strongly controlled by two traits that should be heritable and selectable: (1) the CO2 concentration within the leaf, C, and (2) the specific leaf mass. A detailed model of alfalfa photosynthesis, transpiration, and growth was made. It is predicted that selection for lower C and higher specific leaf mass could improve WUE up to 25% with modest penalties in yield, less than 10%, this indirect selection for WUE appears to have some notable advantages over direct selection. Selection for C and specific leaf mass may also be directly extendable to other crop species. Eighty individual plants of two cultivars, Wilson 9D11A and Mesilla, in controlled environments, were grown. It was found that (1) within each cultivar there are large ranges in C and specific leaf mass, suitable for breeding, and (2) these two traits are related to WUE and yield substantially as predicted by our model. Future effort will proceed to field trials and heritability tests, as well as to studies of drought tolerance traits. (USGS)
W89-11487

POTENTIAL OF IRRIGATED AGRICULTURE IN SYRIA.
A. F. Bichara.
Journal of Water Resources Planning and Management (ASCE) JWRMD5, Vol. 115, No. 3, p 358-366, May 1989. 1 fig, 10 tab, 3 ref.

Descriptors: *Syria, *Irrigation efficiency, *Agricultural hydrology, *Resources development, Land development, Water resources development, Rivers, Springs, Wells, Evaporation.

In the long-term, Syria has a high potential for development of irrigated agriculture. To define this potential, the available water and land resources are assessed. The total area of Syria is about 18,500,000 hectares, of which only 618,000 hectares are under irrigation and 3,117,000 hectares are cropped under rainfed conditions. The available water resources in Syria are estimated at about 25,000,000,000 cubic meters per year, taking into account the Syrian share of international rivers and excluding the Tigris River. Only 54% of the water volume is from the Euphrates River, whereas the rest is divided between the Euphrates tributaries, other rivers, springs, and wells. At present, only 8,900,000,000 cubic meters per year are being used, including 3,000,000,000 cubic meters per year wasted to evaporation or to the sea. In order to fully utilize the available resources, around 1,500,000 hectares may be irrigated. These will utilize about 20,000,000,000 cubic meters per year. This means increasing the area of irrigated land 150% in the future, which is a manageable target. If a rate of development of 80-100,000 hectares per five-year plan is achieved, an expected development period of 40-50 years would be required to develop the country's resources. Present achievements in this regard are around 12,000 hectares per year only. (Author's abstract)
W89-11601

ECONOMIC IMPACTS OF THE LIMITED IRRIGATION-DRYLAND (LID) FURROW IRRIGATION SYSTEM.
Texas Agricultural Experiment Station, College Station.
W. L. Harman, B. A. Stewart, J. T. Musick, and D. A. Dusek.
Water Resources Bulletin WARBAQ, Vol. 25, No. 2, p 367-376 April 1989. 4 fig, 6 tab, 5 ref.

Descriptors: *Agricultural water, *Economic aspects, *Irrigation practices, *Furrow irrigation, Model studies, Texas, Sorghum, Water use, Wheat.

Changes in cropping patterns, water use, and profitability of producing sorghum with the LID (Limited Irrigation-Dryland) furrow irrigation system were compared with conventional irrigation practices. A recursive linear programming model was used to assess the economic impacts over a ten-year period. The analysis of various water resource situations in the High Plains of Texas indicated the LID system increased irrigated sorghum acreage over conventional practices. Although less irrigated and dryland wheat was generally produced, present value of returns increased from about $18/acre to $50/acre. Water use was slightly higher in most situations when using the LID system. (Author's abstract)
W89-11799

AGRICULTURE AND WATER QUALITY.
Economic Research Service, Washington, DC. Resources and Technology Div.
For primary bibliographic entry see Field 5G.
W89-12112

PESTICIDE APPLICATORS SAFETY MANUAL FOR IRRIGATION SYSTEMS.
Bureau of Reclamation, Denver, CO. Div. of Research and Lab. Services.
For primary bibliographic entry see Field 5G.
W89-12129

DRY LAND CROPPING IN AUSTRALIA BY STATES (REGIONS) AND SUB-REGIONS: 1980-81 TO 1983-84.
Commonwealth Scientific and Industrial Research Organization, Canberra (Australia). Div. of Water and Land Resources.
P. Laut.
Commonwealth Scientific and Industrial Research Organization Memorandum 88/12, October 1988. 116p, 77 fig, 20 tab, 1 ref.

Descriptors: *Erosion, *Economic evaluation, *Dry farming, *Australia, Data interpretation, Agriculture, Seasonal variation, Arid-zone hydrology, Semiarid lands, Climatic data.

This Technical Memorandum is part of a larger study of the potential impact of water erosion on the value of dry land crops in Australia. On a state by state basis, seasonal conditions, areas sown, yields, and value of produce are analyzed for the years 1980-81 to 1983-84. These data demonstrate the very considerable variability of conditions experienced at national, state, regional and subregional levels and the difficulty of using such data to determine potential loss of value of production of dry land crops from water erosion. (Author's abstract)
W89-12137

4. WATER QUANTITY MANAGEMENT AND CONTROL

4A. Control Of Water On The Surface

DETENTION POND SIZING FOR MULTIPLE RETURN PERIODS.
Old Dominion Univ., Norfolk, VA. Dept. of Civil Engineering.
For primary bibliographic entry see Field 8A.
W89-11212

TWO DIMENSIONAL MODELLING OF RESERVOIR OUTFLOWS.
Western Australia Univ., Nedlands. Centre for Water Research.
For primary bibliographic entry see Field 2H.
W89-11336

PATHOGENICITY OF THE FUNGUS, COLLETOTRICHUM GLOEOSPORIOIDES (PENZ.) SACC., TO EURASIAN WATERMILFOIL (MYRIOPHYLLUM SPICATUM L).
Wisconsin Univ.-Madison. Dept. of Plant Pathology.
C. S. Smith, S. J. Slade, J. H. Andrews, and R. F. Haris.
Aquatic Botany AQBODS, Vol. 33, No. 1/2, p 1-12, March 1989. 7 fig, 26 ref. EPA grant no. R-811587-01-1.

Descriptors: *Aquatic fungi, *Weed control, *Aquatic weed control, *Plant pathology, *Plant diseases, *Aquatic plants, Pathology, Epidermis, Watermilfoil, Culturing techniques.

The pathogenicity of Eurasian watermilfoil (Myriophyllum spicatum L.) of an isolate of the fungus Colletotrichum gleosporioides (Penz.) Sacc. obtained from diseased milfoil plants was evaluated in laboratory culture experiments. Except in senescent plant tissue, the fungus was confined to the surface of the plant and rarely penetrated beyond the epidermis. Fungal infection prompted a hypersensitive plant response which resulted in the death of a few epidermal cells but evidently halted the internal spread of the fungus. The effect of the fungus was greatest in the commonly used Gerloff's plant culture medium at 25 C. Under these conditions, treated plants did not increase in biomass after innoculation and suffered extensive but superficial damage. At 15 and 20 C, inoculation with the fungus did not produce a detectable reduction in yield. In nutrient-amended lakewater and in a carbonate-buffered artificial growth medium, inoculated plants exhibited little visible damage, but the fungus caused a significant reduction in yield. Because these media supported much greater plant growth than Gerloff's medium, the increase in biomass of inoculated plants was 60-70% that of the control plants. It is concluded that under realistic conditions, the effect of this fungal isolate was too small to justify further consideration of it as a possible biological control agent for M. spicatum. The results illustrate the importance of appropriate culture conditions and media in experiments designed to evaluate microbial pathogens of aquatic plants. (Author's abstract)
W89-11363

APPLICATIONS OF HEADLAND CONTROL.

Western Australia Univ., Nedlands. Dept. of Civil Engineering.
For primary bibliographic entry see Field 2J.
W89-11471

RESERVOIR OVERCOMES LEAK LOSSES.
Cincinnati Water Works, OH.
P. Tomes, G. Fisher, and W. Way.
Water Engineering and Management WENMD2, Vol. 136, No. 5, p 34-38, May 1989.

Descriptors: *Water loss, *Reservoir linings, *Reservoir storage, *Water storage, *Ohio, *Leakage, Reinforced concrete, Flexible membrane linings, Economic aspects, Cost-benefit analysis, Underground storage, Design criteria, Installation.

For over 20 years the Cincinnati Water Works attempted to apply new technologies and some old ones in an effort to curb the leak-loss rate of Eden Park Reservoir, its 80 million gallon underground potable water storage facility. A new reservoir was designed as a reinforced concrete structure that was situated in the basic confines of the old west basin and had a potable water capacity of 80 million gallons. Three design alternatives were investigated: concrete overlay, liquid-applied membrane coating, and loose-laid flexible membrane. A detailed engineering analysis was conducted on each of the alternatives including issues such as service life of materials, ease of installation, effects on water quality, predicted leak-reduction effectiveness and return on investment. Although the flexible membrane material, a potable grade 45-mil Hypalon liner, had a proven leak-reduction capability, the challenge in this project came in the installation process. Problems common to all underground and covered reservoirs include the absence of the warming effects of the sun on the lining membrane; the presence of columns; less than ideal lighting; ever-present dampness which adds to the difficulty of seaming; limited ingress and egress to and from the work area and air-quality problems associated with seaming solvents, contact cements and, in winter, heaters. All these problems were magnified at Eden Park Reservoir because of its size. The basins were completed in two phases, and the first basin was tested for leakage. The results of the initial test indicated 90 percent leak reduction. Upon completion of the second basin, a 95 percent leak reduction was recorded in the south basin. Based on these leak-reduction statistics, Cincinnati Water Works will enjoy a return on its investment in over three years. (White-Reimer-PTT)
W89-11631

COMPENSATION FLOWS IN THE UK: A HYDROLOGICAL REVIEW.
Institute of Hydrology, Wallingford (England).
A. Gustard.
Regulated Rivers Research and Management RRRMEP, Vol. 3, No. 1-4, p 49-59, Jan-Apr 1989. 7 fig, 1 tab, 7 ref.

Descriptors: *Reservoir operation, *Flow control, *Water policy, *River regulations, Hydrodynamics, Flow discharge, Flow pattern, United Kingdom, Reservoirs, Water demand, Flood profiles, Low flow.

A survey of United Kingdom reservoirs identified the development of compensation flow policy from the early 19th Century to the present day. Details on the level and pattern of releases below 261 impounding reservoirs provided the basis for assessing the spatial and temporal variation in compensation flows and the impact of impoundment on downstream flow regimes. By standardizing compensation releases by the natural pre-impoundment mean discharge, release patterns from reservoirs with a wide range of both catchment area and climate could be compared. Analysis of the change in flood and low flow frequency following impoundment enabled the impact of reservoir regulation to be evaluated at the regional scale. For individual reservoirs the natural downstream increase in river flow provides a basis for determining the length of river reach which is sensitive to regime changes. The majority of present day compensation discharges were set to satisfy river interests which no longer apply or were based on inadequate hydrological or biological information. This has led to a wide range of release patterns and it is therefore recommended that the re-evaluation of existing water resource schemes should include an assessment of the suitability of current release patterns for present day downstream demands and water resource requirements. (Author's abstract)
W89-11697

ASSESSING THE IMPACTS OF STREAM REGULATION IN THE FLATHEAD RIVER BASIN, MONTANA, U.S.A. I. SIMULATION MODELLING OF SYSTEM WATER BALANCE.
Montana Univ., Polson. Flathead Lake Biological Station.
C. A. S. Hall, J. H. Jourdonnais, and J. A. Stanford.
Regulated Rivers Research and Management RRRMEP, Vol. 3, No. 1-4, p 61-77, Jan-Apr 1989. 9 fig, 2 tab, 5 ref.

Descriptors: *Dam effects, *Hydrologic budget, *Regulated flow, *River basins, *Simulation analysis, *Model studies, *Hydrologic models, *Flow profiles, *Montana, *Stream discharge, Prediction, Water management, Fortran, Computer programs.

A Fortran-based simulation model was written to predict water movement into and out of Flathead Lake. Since tributaries, the lake proper and downstream flows were either free flowing or regulated by hydroelectric dams, it was necessary for the model to adjust simulated, regulated flows to account for predicted natural flows. Empirical input to the model consisted of daily discharge data or statistical summaries of data sets for an 80+ year period of record for gaging sites on major tributaries, the lake and its outlet river. The model produces graphical output of empirical observations or simulates lake levels and riverine flows on the basis of any selected period of the record. The model was successfully used to evaluate the feasibility of various water management scenarios to enhance or protect fish and wildlife and also permit various hydropower production quotas. It is expected that model output will help resolve water resources management issues in the Flathead system. The hydrology simulator presented may be adapted to any similar system with minimal reprogramming. (Author's abstract)
W89-11698

FRAMEWORK FOR CONTROL OF DYNAMIC ICE BREAKUP BY RIVER REGULATION.
Cold Regions Research and Engineering Lab., Hanover, NH.
M. G. Ferrick, and N. D. Mulherin.
Regulated Rivers Research and Management RRRMEP, Vol. 3, No. 1-4, p 79-92, Jan-Apr 1989. 6 fig, 2 tab, 18 ref.

Descriptors: *Reservoir operation, *Regulated flow, *Ice breakup, *Ice jams, *Stream discharge, *Connecticut River, Model studies, Simulation analysis, Forecasting, Melting.

The mode of failure of an ice cover in a dynamic breakup is determined by geometric and hydraulic conditions, varying between strength-dominated and support-dominated failure at different locations in a river. The fundamental component of the theory presented is the intrinsic relationship between unsteady flow and ice breakup for dynamic breakup conditions with a rapidly moving breaking front. A dynamic ice breakup model that treats support-dominated failure was developed and applied to the Connecticut River. Data from a dynamic breakup was used to obtain empirical criteria for the failure of the support of the ice cover. The relationship between river waves and ice breakup was observed in field data from the White River and was demonstrated in the model simulations of the Connecticut River. The simulations also indicate that when the available storage is limited the breakup response of a river changes from progressive to simultaneous to nonbreakup for the same initial wave by increasing the ice thickness or breakup resistance. These results identify the need for an in situ index test of ice cover resistance. Further refinement and verification of this theory of ice breakup would be achieved most readily by conducting controlled breakup field experiments. This theory of dynamic breakup provides the framework to implement controlled breakup and minimize potential ice related damages on regulated rivers. Control of ice breakup by river regulation uses existing dams, requires a relatively small volume of water, and is environmentally sound. The concept is to remove the ice cover from upstream of locations with a high damage potential during breakup, and to enhance the rate of melting of the ice. (Author's abstract)
W89-11699

RESPONSES OF THE SEDIMENT SYSTEM OF A REGULATED RIVER TO A SCOUR VALVE RELEASE: LLYN CLYWEDOG, MID-WALES, U.K.
Institute of Hydrology, Powys (Wales). Fluvial Geomorphology Unit.
For primary bibliographic entry see Field 2J.
W89-11700

EFFECT OF STREAM REGULATION ON THE PHYSICO-CHEMICAL PROPERTIES OF THE PALMIET RIVER, SOUTH AFRICA.
Cape Town Univ. (South Africa). Dept. of Zoology.
For primary bibliographic entry see Field 6G.
W89-11701

PROPOSALS FOR INHIBITING ABUNDANT PHYTOPLANKTON GROWTH AT THE HEAD OF A RIVER RESERVOIR.
Ehime Univ., Matsuyama (Japan). Dept. of Environment Conservation.
For primary bibliographic entry see Field 5G.
W89-11702

FLUSHING FLOW RECOMMENDATIONS FOR MAINTENANCE OF SALMONID SPAWNING GRAVELS IN A STEEP, REGULATED STREAM.
EA Engineering, Science, and Technology, Inc., Lafayette, CA.
For primary bibliographic entry see Field 8I.
W89-11716

EFFECTS OF RIVER REGULATION ON THE LOWER EBRO RIVER (NE SPAIN).
Barcelona Univ. (Spain). Dept. de Ecologia.
For primary bibliographic entry see Field 6G.
W89-11722

PROBLEMS IN MANAGEMENT OF THE YELLOW RIVER.
Academia Sinica, Beijing (China). Inst. of Geography.
L. Changming.
Regulated Rivers Research and Management RRRMEP, Vol. 3, No. 1-4, p 361-369, Jan-Apr 1989. 3 fig, 4 tab, 7 ref.

Descriptors: *Flood plain management, *Flood protection, *Sediment control, *China, *Yellow River, Management planning, Flow, Deltas, Flood peak, Sedimentation, Flood control, Channel improvement, Interbasin transfers, Multiobjective planning.

The management of the Yellow River, particularly the main problems of flood and sedimentation control in the river's lower reaches is discussed. Peak flows occur mainly in the period from mid-July to late August. Since floods follow storms of high intensity with short duration, characteristics of the resulting floods include a high peak discharge with short duration. As a result of sedimentation, the river's channel in its lower reaches has silted progressively and many sections of the river bed have risen. For the Yellow River, management must focus on the main problems--sediment control in the river's upper and middle reaches and flood-plain management in the lower reaches. Possible flood prevention solutions include: digging a new channel; and maintaining the current channel.

Sediment control considerations include: interbasin water transfers; and delta management. The management work is both complex and broad in scope. The numerous measures exert different long-term and short-term effects on floods and sedimentation. In view of this complexity, measures available and acceptable for flood and sediment control should be combined and coordinated within a systematic framework. (White-Reimer-PTT)
W89-11724

REGULATED RIVERS IN ZAMBIA--THE CASE STUDY OF THE KAFUE RIVER.
Institute for Floodplains Ecology, Rastatt (Germany, F.R.).
P. Obrdlik, A. Mumeka, and J. M. Kasonde.
Regulated Rivers Research and Management RRRMEP, Vol. 3, No. 1-4, p 371-380, Jan-Apr 1989. 6 fig, 3 tab, 20 ref.

Descriptors: *Rivers, *Zambia, *Regulated flow, *Reservoirs, Environmental effects, Hydroelectric power, Chemical analysis, Flood profiles, Conductivity, Sulfates, Chlorides, Case studies, Hydroelectric power, Irrigation water, Flood plains, Ecological effects.

The middle and lower sections of the Kafue River in Zambia are regulated by the Itezhi-tezhi and Kafue Gorge Reservoirs. The Kafue Hydroelectric Scheme has changed the natural flow pattern of the river. Despite temporal changes and the shifting in flow at Kasaka the main feature--high evaporation on the plains--has remained after the regulation. The dredging of new channels was suggested to reduce the evaporation, and in this way to obtain more water for the irrigation of polders planned within the floodplains. The results of water sampling indicate the water quality in the regulated section has not been negatively affected. Conductivity and the concentrations of sulfates and chlorides were reduced. Even if deterioration of the water quality occurred due to release of hypolimnial water the vast and polymorphous floodplain ecosystem would improve the quality quickly and reliably. Spatial and temporal changes in the flood regime have caused a decrease in wild herbivores and some water birds which feed on the seeds of water-lilies have disappeared because the present unfavorable conditions have affected the growth of their food source. Reduced fish production has also occurred, possibly as a result of the inaccessibility of fish camps and changes in the physicochemical status of the water of the regulated stretches. (White-Reimer-PTT)
W89-11725

NEW METHOD FOR ESTIMATING FUTURE RESERVOIR STORAGE CAPACITIES,
Illinois State Water Survey Div., Champaign.
For primary bibliographic entry see Field 2J.
W89-11787

SAMWAT DATABASE FOR COMPUTER MODELS IN WATER MANAGEMENT.
For primary bibliographic entry see Field 10A.
W89-11992

FLUSHING AND SCOURING FLOWS FOR HABITAT MAINTENANCE IN REGULATED STREAMS.
Environmental Protection Agency, Washington, DC. Office of Water Regulations and Standards.
R. W. Nelson, J. R. Dwyer, W. E. Greenberg, and L. E. Keup.
Available from the National Technical Information Service, Springfield, VA 22161, as PB89-101893. Price codes: A10 in paper copy, A01 in microfiche. Final Technical Report, 1988. 190p, 24 fig, 11 tab, 6 append. EPA Contract 68-01-6986.

Descriptors: *Channel scour, *Aquatic habitats, *Regulated flow, *Reservoirs, *Sedimentation, *Flushing, *Reservoir operation, Reservoir silting, Flow control, Reservoir releases, Ecology.

This study explores the feasibility of maintaining and restoring sediment damaged aquatic and riparian habitats through managing reservoir releases to flush deposits of accumulated streambed sediments. Considered are: (1) classifying situations where controlled flushing or scouring could be applied beneficially, predict or evaluate effects, and by purpose; (2) review of pasta successes or failures; (3) methods of predicting flow requirements; and (4) presentation of two case studies (Platte River, NE and Trinity River, CA). Two major problems are the reliability of predictive methods and prediction of sediment loads from disturbed watersheds. Development of flows sufficient to contend with armored or cemented substrates and well developed bank vegetation may be especially difficult because of technical, legal and cost constraints. In many situations controlled reservoir releases will need to be combined with sediment management practices. Institutional problems would likely include: reservoir project repayment contracts, water rights, court decrees, and interstate compacts in addition to reprogramming reservoir operations. Technical considerations include the ecological need and environment trade-offs and site specific conditions including: watershed, flow regimen, sediment or bed composition, and channel morphology. (Author's abstract)
W89-12109

WATER MANAGEMENT OF RESERVOIRS.
Ceske Vysoke Uceni Technicke v Praze. Faculty of Civil Engineering and Architecture.
L. Votruba, and V. Broza.
Elsevier, New York. 1989. 444p.

Descriptors: *Reservoirs, *Water management, *Flood control, *Reservoir operation, Discharge frequency, Stochastic hydrology, Water demand, Water supply, Environmental effects, Reservoir releases, Flood routing, Hydrologic data, Investment, Operating costs, Economic impact.

Reservoirs help to maintain the balance between water resources and water demand. They have a fundamental impact on the environment, a fact which cannot be overlooked in reservoir design and operation. The supply function of reservoirs is explained, and great attention is paid to the processing of hydrological data, the respective probability distribution is assessed, the theory of stochastic processes is explained and methods of modeling the sequence of mean annual and monthly discharges are mentioned. The demands of consumers and the reliability of water supply are analyzed. All types of reservoir discharge control are presented, i.e. multi-year, annual, short-term and compensation. To describe the flood control function of reservoirs, hydrological data are evaluated, the precision of the flood regime characteristics is assessed, and flood routing in a reservoir is resolved. A separate section is devoted to the water management operations of reservoirs. The last part of the book describes solutions for new reservoir functions resulting from their incorporation into water management systems and their interrelations with in the environment. The basic types of water management systems, in which reservoirs are the most important elements, are described, as well as conditions for their operation. Attention is paid to the economically efficient construction of reservoirs. In a similar way the distribution of investment and operation costs for the various parts of a complex water management project are discussed in detail as well as the economic impact of the reliability of water supply and flood control. (Lantz-PTT)
W89-12116

4B. Groundwater Management

WATERSHED MODELS AND THEIR APPLICABILITY TO CONJUNCTIVE USE MANAGEMENT.
Butler Univ., Indianapolis, IN. Holcomb Research Inst.
For primary bibliographic entry see Field 2F.
W89-11168

CHANCE-CONSTRAINED MODEL FOR MANAGEMENT OF STREAM-AQUIFER SYSTEM.
California Univ., Davis. Dept. of Land, Air and Water Resources.
M. M. S. Hantush, and M. A. Marino.
Journal of Water Resources Planning and Management (ASCE) JWRMD5, Vol. 115, No. 3, p 259-277, May 1989. 7 fig, 12 ref, append. Agricultural Research Service Cooperative Agreement 4940-H.

Descriptors: *Model studies, *Surface-groundwater relations, *Groundwater management, *Aquifer management, *Mathematical models, *Pump wells, Optimization, Drawdown, Water table, Well hydraulics, River systems, Permeability coefficient, Specific yield, Aquifers, Induced infiltration, Performance evaluation, Probabilistic process, Variation coefficient, Hydraulic conductivity, Streamflow depletion.

A chance-constrained optimization model for a stream-aquifer system is developed using an approximate solution for the transient drawdown of the water table of an aquifer by a well operating near a river. The model explicitly considers the random nature of the hydraulic conductivity and specific yield of an unconfined aquifer. This enables the determination of the optimal groundwater pumping pattern and induced recharge from the stream to the aquifer (i.e., stream depletion rate) under specified system performance probability requirements. An application of the model is demonstrated using a hypothetical problem, and the sensitivity of the results is examined by varying probability requirements and the statistical properties of the aquifer parameters, which are: the coefficient of variation of the log-hydraulic conductivity; the coefficient of variation of the log-specific yield; and the correlation between the log-hydraulic conductivity and log-specific yield. The results obtained by the model indicate that the optimal pattern of pumping rates obtained by the management policy are highly sensitive to the probability and coefficient of variation of the log-hydraulic conductivity. The induced rate of stream depletion is insensitive to the coefficient of variation of the log-specific yield and is slightly sensitive to the probability levels. In contrast, the induced stream depletion rate is highly sensitive to the hydraulic conductivity statistics. (Author's abstract)
W89-11596

DIAGNOSIS OF SEVENTY MUNICIPAL WATER SUPPLY BOREHOLES IN LIMA, PERU.
Binnie and Partners, Redhill (England).
For primary bibliographic entry see Field 3B.
W89-11681

OPTIMAL CONTROL OF GROUNDWATER BY THE FEEDBACK METHOD OF CONTROL.
California Univ., Davis. Dept. of Land, Air and Water Resources.
B. A. Makinde-Odusola, and M. A. Marino.
Water Resources Research WRERAO, Vol. 25, No. 6, p 1341-1352, June 1989. 5 fig, 9 tab, 17 ref. University of California Water Resources Center Project UCAL-WRC-W-697.

Descriptors: *Groundwater movement, *Groundwater management, *Automation, *SUTRA Model, Optimization, Piezometric surfaces, Management planning, Pumping, Computer programs, Hydraulic models, Simulation.

The feedback method of optimal control was employed to solve groundwater hydraulic management problems such as maintaining a target piezometric surface within a confined aquifer. The feedback model for groundwater hydraulic management consists of a modified version of the groundwater model SUTRA coupled to a dynamic programming optimization model. A quadratic criterion representing a weighted sum of squared deviations from a target piezometric surface was chosen as the objective function. Under this criterion, a set of feedback rules for predicting optimal pumping strategies for the next time period based on current piezometric head values are a by-product of the solution. The computed feedback rule coefficients are used to derive the optimal pumping strategy for the groundwater hydraulic management problem. The feedback model is shown to be an inverse groundwater simulation model in that

piezometric heads are used to determine the optimal pumping rate. (Author's abstract)
W89-11774

MATHEMATICAL ANALYSIS OF ARTIFICIAL RECHARGE FROM BASINS.
Colorado State Univ., Fort Collins.
J. W. Warner, D. Molden, M. Chehata, and D. K. Sunada.
Water Resources Bulletin WARBAQ, Vol. 25, No. 2, p 401-411, April 1989. 4 fig, 4 tab, 18 ref. Colorado Experiment Station Project 1-51101.

Descriptors: *Groundwater management, *Artificial recharge, *Mathematical analysis, *Groundwater recharge, Mathematical studies, Mathematical equations, Groundwater movement, Recharge basins.

One of the most common methods of artificial recharge to the groundwater is from basins. Seven analytical solutions of artificial recharge from basins are described:(1) Baumann's method for circular basins; (2) Glover's method for circular basins; (3) Glover's method for rectangular basins; (4) Hantush's method for circular basins; (5) Hantush's method for rectangular basins; (6) Rao and Sarma's method for rectangular basins; and (7) Hunt's method for circular basins. Most of these solutions are derived by directly solving the general partial differential equation for groundwater flow. The solutions differ in that they use different boundary conditions basin shapes, and consider the nonlinearity of the artificial recharge problem differently. Use of each analytical solution is demonstrated by application to an example problem, and a comparison of each analytical solution was made to give suggestions on their use, their ease of implementation, and their relative agreement. Although no attempt is made to conclude which analytical solution is best for all problems, some general conclusions can be stated on the applicability of the various analytical solutions. Of the analytical solutions presented, Glover's and Hantush's solutions for rectangular recharge basins are highly recommended. Baumann's solution for a circular basin also gave fairly reliable results and is very easy to evaluate numerically. (Author's abstract)
W89-11803

TRANSITIONS IN MIDWESTERN GROUND WATER LAW.
Illinois State Water Survey Div., Champaign.
For primary bibliographic entry see Field 6E.
W89-11804

HOMEOWNER'S GUIDE TO DOMESTIC WELLS.
Virginia Water Resources Research Center, Blacksburg.
For primary bibliographic entry see Field 5G.
W89-11888

GROUND-WATER RESOURCES OF JASPER AND NEWTON COUNTIES, TEXAS.
For primary bibliographic entry see Field 2F.
W89-11890

PROCEEDINGS OF THE FOCUS CONFERENCE ON EASTERN REGIONAL GROUND WATER ISSUES.
For primary bibliographic entry see Field 2F.
W89-11916

RELIABILITY OF GROUNDWATER MODELING FOR THE ANALYSIS OF QUARRY DEWATERING.
Dunn Geoscience Corp., Albany, NY.
For primary bibliographic entry see Field 4C.
W89-11939

GROUND WATER RISK MANAGEMENT ON CAPE COD: THE APPLICABILITY OF GEOGRAPHIC INFORMATION SYSTEM TECHNOLOGY.
Environmental Protection Agency, Boston, MA. Region I.
L. Steppacher.
IN: Proceedings of the FOCUS Conference on Eastern Regional Ground Water Issues, September 27-29, 1988, Stamford, Connecticut. National Water Well Association, Dublin, Ohio, 1988. p 427-461, 12 fig.

Descriptors: *Risk assessment, *Water pollution prevention, *Groundwater management, *Groundwater quality, *Cape Cod, *Information systems, *Geographic information systems, Data interpretation, Geohydrology, Simulation analysis, Aquifer management, Interagency cooperation, Geography.

The Cape Cod Aquifer Management Project (CCAMP), a two year collaborative effort initiated by the US Environmental Protection Agency (EPA), US Geological Survey (USGS), Massachusetts Dept. of Environmental Quality Engineering and the Cape Cod Planning and Economic Development Commission was charged with developing an integrated, resource-based approach to groundwater management. CCAMP searched for a method of compiling all significant factors needed to undertake a comprehensive analysis of the groundwater resource and its threats. CCAMP chose geographic information system (GIS) technology to undertake such an analysis and to demonstrate its applicability in groundwater management. The purposes of the demonstration were multi-faceted, including evaluation of its utility in groundwater risk management, identifying problems encountered in its application, and assessing transferability of the results. Scenarios for applying GIS to groundwater management were developed to identify data requirements, illustrate spatial relationships between wells and contaminant sources, analyze risks, and provide insights into management approaches. Scenarios included analyses at three scales study, a wellhead protection area in Barnstable, the Town of Eastham, and Cape Cod as a region. Management issues examined included siting of a new public water supply, inter-town management of a wellhead protection area, potential threats due to build out of zoning regulations, and ranking of threat posed by underground storage tanks and landfills. The professional presentation of GIS generated maps and the level of detail which can be attained minimize the margin of error which can be encorporated. Conclusions of the demonstration project focused on the critical need for accuracy in geographic and attribute data and the need for a strong scientific basis to support the analyses. The role GIS may play in groundwater management within state, regional and local governments is examined, including its potential to stimulate additional analysis because of its interactive capabilities and the ease with which refinements may be made. (See also W89-11916) (Author's abstract)
W89-11941

SUFFOLK COUNTY WATER AUTHORITY WATERSHED PROTECTION STRATEGY.
Suffolk County Water Authority, Oakdale, NY.
For primary bibliographic entry see Field 6A.
W89-11942

DETERMINATION OF SAFE YIELD FOR PUBLIC SUPPLY WELL FIELDS IMPACTED BY SALT-WATER UPCONING IN EASTERN LONG ISLAND.
Leggette, Brashears and Graham, Inc., Wilton, CT.
J. B. Lennox.
IN: Proceedings of the FOCUS Conference on Eastern Regional Ground Water Issues, September 27-29, 1988, Stamford, Connecticut. National Water Well Association, Dublin, Ohio, 1988. p 469-491, 8 fig, 4 tab, 23 ref.

Descriptors: *Safe yield, *Water supply, *Water pollution control, *Groundwater quality, *Saline water intrusion, *Long Island, *Groundwater management, Chlorides, Wells, Aquifers, Saline water, Groundwater mining, Data interpretation, Pumpage.

The Montauk area of the South Fork of Long Island is a summer resort area served exclusively by groundwater. The year-round population is relatively small but increases dramatically in the summer. The water demand corresponds not only to normal seasonal patterns, but also to the population flux. Eight of the nine Suffolk County Water Authority supply wells have shown high chlorides during periods of heavy summer pumpage. The wells have fixed pumping rates; therefore, the degree of upconing depends on the duration of pumpage. To determine the safe yield of the individual wells, six years of pumpage and chloride data were entered into a database and plotted together versus time. Another set of plots were prepared which show the seasonal chloride highs and lows with the corresponding seasonal and monthly total pumpage noted next to the chloride data, and precipitation data. Two determinations were made with the data. First, the maximum daily, monthly and seasonal pumpage were determined which would result in chlorides remaining within acceptable limits. Second, the data were evaluated to determine if there was evidence of aquifer degradation due to a widening of the transition zone between fresh and salt water. The study revealed that many of the wells show a long-term increase in chloride concentrations. Some of the chloride increases, however, are due to increasing pumpage, which temporarily upcones more saline water, but has not necessarily degraded the condition of the aquifer. The maximum pumpage recommendations should control the high chlorides. (See also W89-11916) (Author's abstract)
W89-11943

CHALLENGES IN CREATING A LOCAL GROUNDWATER PROTECTION PLAN.
Housatonic Valley Association, Cornwall Bridge, CT.
L. A. Werner, and S. C. Peterson.
IN: Proceedings of the FOCUS Conference on Eastern Regional Ground Water Issues, September 27-29, 1988, Stamford, Connecticut. National Water Well Association, Dublin, Ohio, 1988. p 493-509.

Descriptors: *Water pollution prevention, *Local governments, *Groundwater management, *Management planning, *Connecticut, *Groundwater quality, Groundwater pollution, Monitoring, Public participation, Regulations.

In Connecticut, groundwater pollution can be effectively prevented at the local level since the majority of land use activities are regulated by municipalities. However, land use decisions are typically made by well-meaning volunteer boards and commissions with little or no expertise in groundwater flow, contamination or protection. Communities need assistance in designing local groundwater protection measures. The Housatonic Valley Association (HVA), a private, nonprofit conservation organization, designed and implemented a grant-funded project to test a theoretical process for local groundwater protection. The project's goal was to identify the steps necessary to create scientifically sound, legally defensible, and locally practical groundwater protection programs. This paper describes the process, the successes and obstacles encountered and how the process subsequently changed. Working with four Connecticut towns, HVA tested methods for bringing resource specialists together with town officials and volunteers to collect and interpret technical data; pinpoint local groundwater supplies and potential contamination problems; promote widespread understanding of groundwater and the need to protect it; examine specific town needs and capabilities; and ultimately, create protection programs. In exploring this process, HVA encountered several unanticipated obstacles, such as a lack of scientific data for delineating protection boundaries; disagreement among resource experts regarding the effectiveness of certain protection measures; and local resistance to monitoring existing activities which may pose a threat to groundwater. By identifying and addressing such problems, the project has served to modify and refine a process which towns will find useful in creating protection programs. (See also W89-11916) (Author's abstract)
W89-11944

SAMWAT DATABASE FOR COMPUTER MODELS IN WATER MANAGEMENT.
For primary bibliographic entry see Field 10A.
W89-11992

ANALYSIS OF WATER-LEVEL FLUCTUATIONS IN WISCONSIN WELLS.
Geological Survey, Madison, WI. Water Resources Div.
For primary bibliographic entry see Field 2F.
W89-12136

4C. Effects On Water Of Man's Non-Water Activities

WATER SUPPLY IMPACTS OF NUCLEAR FALL.
Case Western Reserve Univ., Cleveland, OH. Dept. of Systems Engineering.
B. F. Hobbs, Y. Luo, M. E. Maciejowski, and C. V. Chester.
Water Resources Bulletin WARBAQ, Vol. 25, No. 1, p 1-13, February 1989. 2 fig, 1 tab, 27 ref. U.S. Department of Energy contract DE-AC05-840R21400.

Descriptors: *Nuclear war, *Nuclear winter, *Nuclear fall, *Water supply, *Groundwater availability, Drought, Surface water availability.

'Nuclear winter,' more properly called 'nuclear fall,' could be caused by injection of large amounts of dust into the atmosphere. Besides causing a decrease in temperature, it could be accompanied by 'nuclear drought,' a catastrophic decrease in precipitation. Dry land agriculture would then be impossible, and municipal, industrial, and irrigation water supplies would be diminished. It has been argued that nuclear winter/fall poses a much greater threat to human survival than do fallout or the direct impacts of a conflict. However, this does not appear to be true, at least for the U.S. Even under the unprecedented drought that could result from nuclear fall, water supplies would be available for many essential activities. For the most part, groundwater supplies would be relatively invulnerable to nuclear drought, and adequate surface supplies would be available for potable uses. This assumes that conveyance facilities and power supplies survive a conflict largely intact or can be repaired. (Author's abstract)
W89-11156

STORM RUNOFF CHARACTERISTICS OF GRAZED WATERSHEDS IN EASTERN OREGON.
Chequamegon National Forest, Park Falls, WI.
For primary bibliographic entry see Field 2E.
W89-11164

SIMULATION OF THE EFFECTS OF URBANIZATION ON BASIN STREAMFLOW.
Canada Centre for Inland Waters, Burlington (Ontario).
H. Y. F. Ng, and J. Marsalek.
Water Resources Bulletin WARBAQ, Vol. 25, No. 1, p 117-124, February 1989. 3 fig, 4 tab, 11 ref.

Descriptors: *River basins, *Streamflow, *Urbanization, *Flooding, *Flood peak, *Urban hydrology, *Hydrologic models, *Simulation, Runoff, Waterford River Basin, Newfoundland, Canada.

The hydraulic modeling of streamflow in the Waterford River Basin was conducted as part of comprehensive investigations of the effects of urbanization on water resources in the basin. Using a detailed input data base, continuous simulation of streamflow in the study area was done by means of the HSPF (Hydrological Simulation Program-Fortran) model, which was calibrated for the existing conditions and then applied to several future land use scenarios. The basin climate and geology contribute to high conversion of precipitation into streamflow under the existing conditions. Consequently, future urban development in the study basin should not increase annual streamflow, but would contribute to increases in peak flows and the incidence of flooding because of the increased speed of runoff. If the impervious area in the basin is doubled, the peak flows may increase by about 20%. (Author's abstract)
W89-11167

HYDROLOGIC RESPONSES TO DEVELOPMENT IN REGIONAL SEDIMENTARY AQUIFERS.
Geological Survey, St. Simons Island, GA.
R. H. Johnston.
Ground Water GRWAAR, Vol. 27, No. 3, p 316-322, May-June 1989. 3 fig, 14 ref.

Descriptors: *Geohydrology, *Aquifer systems, *Groundwater depletion, *Groundwater mining, *Regional development, *Water table decline, Hydrologic properties, Groundwater storage, Water level, Groundwater level, Groundwater recharge, Groundwater movement.

The hydrologic response to development of three of the most heavily pumped sedimentary aquifer systems in the United States is reviewed. In the semiarid West, an unconfined sand aquifer and a confined sand and clay aquifer system have been subjected to withdrawals that are far greater than predevelopment recharge rates. As a result, the aquifers have large losses of groundwater from storage. However, the following responses to development are common in all three aquifer systems: (1) groundwater circulation has increased, (2) rates of recharge have increased, mostly due to recirculation of pumped groundwater, or infiltration of imported surface water used for irrigation in the semiarid West, (3) locations of recharge areas have changed, and (4) natural discharge has decreased. Regional water level declines associated with groundwater developments are inevitably accompanied by some combination of elastic compaction of aquifer material, inelastic compaction of aquifer material, inelastic compaction of fine-grained sediments and land subsidence, dewatering of aquifer material near pumping centers, and induced formation of sinkholes. The degree to which these changes occur is dependent on: (1) rates of pumping in relation to available recharge, and (2) lithology, specifically the proportion of sand, gravel, silt, clay, and carbonate rock that comprise the aquifer system. (Author's abstract)
W89-11274

USE OF THE STRUCTURAL MODEL FOR THE ASSESSMENT OF ENVIRONMENTAL IMPACT ON COASTAL FISHERIES: AN APPLICATION,
Tokyo Univ. (Japan). Ocean Research Inst.
H. Nakata, and T. Hirano.
Nippon Suisan Gakkaishi (Bulletin of the Japanese Society of Scientific Fisheries) NSUGAF, Vol. 55, No. 2, p 279-286, February 1989. 8 fig, 2 tab, 5 ref.

Descriptors: *Case studies, *Environmental policy, *Environmental effects, *Coastal zone management, *Water pollution effects, *Marine fisheries, Coastal waters, Sediment discharge, Model studies.

A case study of the use of the structural model for the assessment of environmental impact on the coastal fisheries is presented. The study focused on the impact of sediment discharge due to reclamation work, and an impact indicator was identified as differential catch of small shrimps in the proposed area. Eight environmental factors including use of increase of turbidity (C1) as input and the catch loss of the small shrimps (F1) as output, and interactions among them were identified. The interactions were formulated by using remaining ratios (a set of variables each of which indicate the rate deviation from the present state of each environmental factor) as variables. Each remaining ratio is normalized over the range (0-1); the upper boundary for the present state and the lower boundary for the largest impacted state. By inputting predicted initial remaining ratio to C1, the possible impact on F1 could be quantified. The effect-impact sequence of the structural model showed that the reduction in the area of the algal belt (factor B2) may have a major impact on the abundance of small shrimps in addition to the reduction in primary production (factor B1) due to the turbidity increase. The utility of the structural model is that it allows easy visualization of the extent to which the coastal fisheries system can be affected in a concrete situation. Nevertheless, its estimate of the impact is still primitive; it is therefore helpful to make use of other estimates together; the output of the structural model is just one of the important pieces of information to be considered in the environmental impact assessment. (Friedmann-PTT)
W89-11290

PREDICTION OF SALT TRANSPORT DURING LEACHING OF SALINE SOILS FOR RECLAMATION.
Orissa Univ. of Agriculture and Technology, Bhubaneswar (India). Dept. of Soils and Agricultural Chemistry.
For primary bibliographic entry see Field 2K.
W89-11382

SEDIMENT BUDGET FOR A SMALL AGRICULTURAL WATERSHED.
Division of Reactor Research and Development (AEC), Washington, DC.
For primary bibliographic entry see Field 2J.
W89-11504

DYNAMICS OF DISSOLVED ORGANIC CARBON IN FORESTED AND DISTURBED CATCHMENTS, WESTLAND, NEW ZEALAND: 1. MAIMAI.
McGill Univ., Montreal (Quebec). Dept. of Geography.
T. R. Moore.
Water Resources Research WRERAO, Vol. 25, No. 6, p 1321-1330, June 1989. 6 fig, 4 tab, 58 ref.

Descriptors: *New Zealand, *Dissolved solids, *Organic carbon, *Forest watersheds, Detritus, Clear-cutting, Hardwood, Cycling nutrients, Maimai, Iron, Aluminum, Flow discharge, Correlation analysis, Hydrographs, Storm runoff.

Dissolved organic carbon (DOC) dynamics were investigated in two undisturbed catchments (beech-podocarp-hardwood forest) and six catchments that had been clear-cut 8-10 yr previously and planted with pine. Over a 4-mo sampling period, DOC concentrations in an undisturbed catchment averaged 1.4, 16.0, 356.0, and 55.7 mg/L in precipitation, throughfall, stemflow, and surface organic horizon, respectively. DOC concentrations decreased to averages of 11.8 and 4.5 mg/L in the subsoil and stream, respectively. The annual flux of DOC was estimated as an input through precipitation of 3.4 g/sq m, 83.6 g/sq m through the organic horizon, and an export of 6.8 g/sq m in the stream. The pronounced decrease in DOC concentration and flux in the subsoil horizon is related to the high concentrations of amorphous, oxalate-extractable Fe, and Al with high DOC-adsorption capacities. In streams draining the eight catchments, discharge-weighted DOC concentrations ranged for 4.5 to 10.2 mg/L. DOC and log discharge showed a significant positive relationship and the rising limb of the storm hydrograph contained higher DOC concentrations than the falling limb, at similar discharges. Export of DOC in 1986 ranged from 8 to 21 g/sq m and was related to the type of disturbance: the lowest values were recorded in undisturbed catchments and the highest in catchments that had been clear-cut and the slash had not been burnt. Organic debris in the stream channel appear to be important sources of stream DOC and probably account for the higher DOC concentrations in the disturbed catchments observed 8-10 yr after disturbance. (See also W89-11773) (Author's abstract)
W89-11772

DYNAMICS OF DISSOLVED ORGANIC CARBON IN FORESTED AND DISTURBED CATCHMENTS, WESTLAND, NEW ZEALAND: 2. LARRY RIVER.
McGill Univ., Montreal (Quebec). Dept. of Geography.

T. R. Moore, and R. J . Jackson.
Water Resources Research WRERAO, Vol. 25, No. 6, p 1331-1339, June 1989. 5 fig, 5 tab, 43 ref.

Descriptors: *New Zealand, *Dissolved solids, *Organic carbon, *Forest watersheds, Detritus, Forest management, Clear-cutting, Pine trees, Hardwood, Cycling nutrients, Larry River, Anions, Hydrogen ion concentration, Flow discharge, Correlation analysis, Hydrographs, Storm runoff.

Dissolved organic carbon (DOC) dynamics were investigated in three small wetland catchments: one covered by a scrub forest and the other two cleared, V-bladed, and planted with pine, 1 and 4 yr before sampling. Over a 4-mo sampling period, DOC concentrations averaged 1.4, 20.9, 47.1, 46.0, and 45.7 mg/L in precipitation, throughfall, stemflow, surface soil water, and subsoil water, respectively, in the scrub forest catchment. DOC concentration in the stream draining the catchment averaged 43.4 mg/L, reflecting the inability of the Larry River subsoils to adsorb DOC and the pathways taken by water. In 1986, discharge-weighted DOC concentrations in the streams ranged from 29.9 mg/L in the catchment disturbed 4 yr before sampling to 35.0 mg/L in the recently disturbed catchment and 37.9 mg/L in the catchment covered by scrub forest. DOC export from the catchments in 1986 was estimated to be 30.6, 43.8, and 41.7 g/sq m/yr, suggesting that disturbance had a minor effect on DOC export. The role of the high DOC concentrations on the chemistry of the stream water was revealed by a large anion deficit, an average anion deficit:DOC relationship of 5.7 meq/g, and an annual export of acidity of 184-263 meq/sq m/yr. Within-storm sampling showed that pH and DOC were related inversely, and base titration suggested acid dissociation constants ranging from 4.4 to 4.9. (See also W89-11772) (Author's abstract)
W89-11773

EFFECTS OF ISOLATION ON THE WATER STATUS OF FOREST PATCHES IN THE BRAZILIAN AMAZON.
Missouri Botanical Gardens, St. Louis.
V. Kapos.
Journal of Tropical Ecology JTECEQ, Vol. 6, No. 2, p 173-185, May 1989. 8 fig, 20 ref.

Descriptors: *Brazil, *Environmental effects, *Rain forests, *Isolation, *Soil-water-plant relationships, *Humidity, Soil water, Photosynthesis, *Amazon, Air temperature, Saturation deficit, Soil water potential, Microclimates, Transpiration.

Patterns of edge-related environmental changes and plant water relations were investigated in the isolated forest reserves of the National Institute for Amazonian Research-World Wildlife Fund (INPA-WWF) Minimum Critical Size Ecosystems project near Manaus (Brazil) early in the wet season. Air temperature was elevated and humidity reduced in the understorey within 40 m of the reserve margins, and air temperature and vapor pressure deficit (VPD) were higher in the interiors of 1 ha reserves than in 100 ha reserves. There was increased photosynthetically active radiation penetration to understorey level up to 40 m into a 100 ha reserve, soil moisture was depleted in the outer 20 m of both small and large reserves, and surface soil water potentials fell below--1.5 MPa at the margin of a 1 ha reserve. Studies of the leaf relative water contents (RWCs) in understorey shrubs revealed no appreciable saturation deficits, although RCs were sometimes lower at reserve margins. Studies of leaf conductances revealed no evidence of restriction of water loss in these plants, and conductances of plants near the edges were significantly higher and higher for longer. The principal importance of the microclimatic changes related to the reserve edges is in the increase in evaporative demand they represent. The depletion of soil moisture near the reserve margins is evidence that this increased evaporative demand did indeed cause increased evapotranspiration. The magnitude of the decrease in soil water potential near the reserve margin suggests that water shortage could indeed be a factor in increased tree mortality. However, the measurements of understorey plant water status failed to show any measurements of understorey plant water status failed to show any evidence of severe water deficits, but this may simply reflect the fact that they were made during the rainy season. Alternatively, the plants may avoid water deficits by closing their stomata and reducing their transpirational losses. The conductance data suggests that such a response may exist. (Miller-PTT)
W89-11819

WATER-QUALITY ASSESSMENT USING AQUATIC MACROINVERTEBRATES FROM STREAMS OF THE LONG PINE CREEK WATERSHED IN BROWN COUNTY, NEBRASKA,
Nebraska State Dept. of Environmental Control, Lincoln. Water Quality Div.
For primary bibliographic entry see Field 6G.
W89-11821

OVERVIEW OF MARINE ENVIRONMENTAL QUALITY IN THE CANADIAN ARCTIC,
Environmental Protection Service, Yellowknife (Northwest Territories).
G. A. Packman, and R. G. Shearer.
IN: Canadian Conference on Marine Environmental Quality: Proceedings, February 29-March 3, 1988, Halifax, Nova Scotia. The International Institute for Transportation and Ocean Policy Studies, 1236 Henry St., Halifax, Nova Scotia, Canada. 1988. p 229-242, 1 fig, 1 tab, 45 ref.

Descriptors: Environmental quality, *Resources development, *Marine environment, *Arctic, *Canada, Water pollution effects, Oil pollution, Lead, Zinc, Mine wastes, Trace metals, Heavy metals, Nonpoint pollution sources, Water pollution sources, Toxaphene, DDT, Polychlorinated biphenyls, Fate of pollutants, Environmental effects, Resources management.

While the Arctic marine environment has remained relatively untouched by modern industrial development to date, both direct and indirect impacts from development are beginning to appear. Development has been initiated primarily by oil and gas exploration activity in the Beaufort Sea and Arctic Islands, as well as by lead/zinc mining on Little Cornwallis Island and Baffin Island. Shorebase support facilities for offshore oil and gas exploration, fuel transfer facilities, two lead/zinc mines, and municipalities constitute the primary land-based point sources of pollution. Offshore oil and gas exploration wells and production facilities constitute the other class of point source inputs, resulting in increased hydrocarbon loading from chronic spills, the use and disposal of oil-based drilling muds, and the discharge of produced water. Trace metal loadings to the sediments may also result from the discharge of spent drilling muds. Trace metal concentrations increase around mining operations as a result of the discharge of effluent from tailings ponds and the loss of ore concentrates during ship loading. Municipalities discharge raw sewage or effluent from sewage lagoons into the marine environment. The physical, chemical, and biological impacts around point sources are generally confined to their immediate vicinity. It is becoming increasingly clear that nonpoint source impacts from land-based activities warrant attention. This paper provides an analysis of anthropogenic inputs and their impact, a brief description of the legislative base and management structure for addressing development-related impacts, and an assessment of priority needs to ensure that the quality of the Arctic marine environment is well understood and protected. (See also W89-11852) (Lantz-PTT)
W89-11865

ENVIRONMENTAL ASSESSMENT OF REMEDIAL ACTION AT THE RIVERTON URANIUM MILL TAILINGS SITE, RIVERTON, WYOMING. VOLUME I: TEXT.
Environmental Monitoring and Support Lab.-Cincinnati, OH. Biological Methods Branch.
October, 1984. 219p, 24 fig, 16 tab, 105 ref. DOE Contract DE-AC04-82AL14086.

Descriptors: *Environmental effects, *Radioactive wastes, *Water pollution prevention, *Waste disposal, *Cleanup operations, *Mine drainage, *Uranium, *Wyoming, Riverton, Soil contamination, Groundwater pollution, Erosion control, Barriers, Comparison studies.

This document assesses and compares the environmental impacts of various alternatives for remedial action at the Riverton uranium mill tailings site located 2 miles southwest of Riverton, Wyoming. The site covers 173 acres and contains 70 acres of tailings and several of the original mill structures. The Uranium Mill Tailings Radiation Control Act of 1978 (UMTRCA), Public Law 95-604, authorizes the US Department of Energy to clean up the site to reduce the potential health impacts associated with the residual radioactive materials remaining at the site and at associated properties off the site. The US Environmental Protection Agency promulgated standards for the remedial actions (40 CFR 192). Remedial actions must be performed in accordance with these standards and with the concurrence of the Nuclear Regulatory Commission. The preferred alternative is to stabilize the tailings at their present location by consolidating the tailings and associated contaminated soils into a recontoured pile. A radon barrier of compacted earth would be constructed over the pile, and various erosion control measures would be taken to assure the long-term stability of the pile. An underground bentonite slurry wall would be constructed around the perimeter of the stabilized pile to minimize additional groundwater contamination. Another alternative which would involve moving the tailings to a new location is also assessed in this document. This alternative would generally involve greater short-term impacts and costs but would result in stabilization of the tailings at a more remote location. The no action alternative is also assessed in this document. (Author's abstract)
W89-11880

ENVIRONMENTAL EVALUATION OF POTENTIAL PETROLEUM DEVELOPMENT ON THE NATIONAL PETROLEUM RESERVE IN ALASKA.
December 15, 1979. 238p, 14 fig, 8 tab, 35 ref, 3 append.

Descriptors: *Resources development, *Environmental impact, *Water pollution effects, *Management planning, *Alaska, *Environmental protection, *Oil industry, Oil pollution, Social aspects, Environmental impact statement, Gravel, Arctic, Wildlife.

This is an environmental analysis of potential development, production, transportation, and distribution of petroleum resources from the National Petroleum Reserve in Alaska (NPRA). Because no specific programs have been developed to date in NPRA, no site-specific analyses of impacts are possible. Such analyses will be possible only when specific lease sites and programs are identified. This impact analysis therefore considers those anticipated impacts that could likely be associated with future potential development. The principal environmental concerns stemming from development and production are: impacts on the Inupiat culture and lifestyle, particularly through effects on subsistence pursuits; impacts on wildlife, especially on caribou and waterbirds; and depletion of gravel and water resources, which are in limited supply. (Lantz-PTT)
W89-11897

HIGHWAY DEICING SALT CONTAMINATION PROBLEMS AND SOLUTIONS IN MASSACHUSETTS.
Massachusetts Dept. of Public Works, Lexington. Research and Materials Section.
For primary bibliographic entry see Field 5B.
W89-11937

RELIABILITY OF GROUNDWATER MODELING FOR THE ANALYSIS OF QUARRY DEWATERING.
Dunn Geoscience Corp., Albany, NY.
W. J. Miller.
IN: Proceedings of the FOCUS Conference on

Eastern Regional Ground Water Issues, September 27-29, 1988, Stamford, Connecticut. National Water Well Association, Dublin, Ohio, 1988. p 385-409, 12 fig, 12 ref.

Descriptors: *Groundwater movement, *Quarries, *Model studies, *Dewatering, New York, Case studies, Geohydrology, Rock excavation, Porous media, Groundwater level.

There are many existing and proposed rock and sand and gravel quarries in the northeast supplying aggregate materials for the construction of roads and buildings. Many of these quarries either are or will require dewatering. Since dewatering involves the dynamic management of groundwater, often over long periods of time, its regulation must be preceded by some advance planning including and Environmental Impact Statement. As a part of this planning, predictive analyses are frequently performed to determine the amount of pumpage required for the dewatering as well as the impact of the dewatering on neighboring water supplies and surface water resources. A case history is presented which illustrates the use of a porous media numerical model for the evaluation of dewatering the Lockport dolomite in Central New York for a proposed quarry. The primary objectives were typical of quarry dewatering analyses. They addressed the estimated pumpage required to dewater the proposed quarry, the determination of the impacts on the water levels in the surrounding area, the estimation of the length of time required to fill the quarry with water after mining is completed, and the evaluation of various options to minimize potentially adverse drawdowns caused by dewatering. This study illustrates how porous media models can provide valuable insight regarding the dewatering of fractured formations. (See also W89-11916) (Lantz-PTT)
W89-11939

WATER POLLUTION AND ASSOCIATED EFFECTS FROM STREET SALTING.
Environmental Protection Agency, Edison, NJ. Storm and Combined Sewer Technology Branch.
For primary bibliographic entry see Field 5B.
W89-11976

ENVIRONMENTAL ASPECTS OF RIGHTS-OF-WAY FOR NATURAL GAS TRANSMISSION PIPELINES: AN UPDATED BIBLIOGRAPHY.
Argonne National Lab., IL. Energy and Environmental Systems Div.
B. J. Sullivan, A. C. McGraw, and D. O. Johnson.
Final Report No. GRI-88/0319, June 1988. 392p, 1400 ref. Gas Research Institute Contract 5082-254-00690.

Descriptors: *Right-of-way, *Pipelines, *Environmental effects, *Natural gas, *Bibliographies, Aquatic environment, Information exchange, Wetlands, Water quality, Legal aspects.

This bibliography lists over 1,400 references, some 600 obtained since Argonne National Laboratory's 1984 preparation of a similar bibliography. The references include books, journal articles, conference and symposium proceedings, government and industrial reports, workshop proceedings, dissertations and theses, and bibliographies. Nine data bases were searched and more than 60 organizations were contacted to identify literature on environmental aspects of the installation of gas pipelines. The data bases searched were: Agricola, Aquatic Sciences and Fisheries Abstracts, Compendex, Conference Papers Index, DOE Energy, Enviroline, Environmental Bibligraphy, NTIS, and Water Resources Abstracts. Keywords searched include: aquatic community, biomass, ecosystem, environmental impact, environmental management, estuary, horizontal drilling, joint-use-corridor, pipeline construction, pipeline right-of-way, right-of-way, soil, water chemistry, water quality, wetland characterization, wetland management, and wetlands. (Lantz-PTT)
W89-12092

4D. Watershed Protection

ESTIMATING THE WATER QUALITY BENEFITS FROM SOIL EROSION CONTROL.
Economic Research Service, Washington, DC. Resources and Technology Div.
For primary bibliographic entry see Field 5G.
W89-11162

IMPACT OF STOCKWATERING PONDS (STOCKPONDS) ON RUNOFF FROM LARGE ARIZONA WATERSHEDS,
Arizona Attorney General's Water Rights Adjudication Team, Phoenix.
For primary bibliographic entry see Field 6E.
W89-11173

RESPONSES OF THE SEDIMENT SYSTEM OF A REGULATED RIVER TO A SCOUR VALVE RELEASE: LLYN CLYWEDOG, MID-WALES, U.K.
Institute of Hydrology, Powys (Wales). Fluvial Geomorphology Unit.
For primary bibliographic entry see Field 2J.
W89-11700

WEST BRANCH SUSQUEHANNA RIVER SUBBASIN: LOW FLOW MANAGEMENT FRAMEWORK PLAN.
Susquehanna River Basin Commission, Harrisburg, PA.
For primary bibliographic entry see Field 6D.
W89-12103

5. WATER QUALITY MANAGEMENT AND PROTECTION

5A. Identification Of Pollutants

LEGIONELLA AND PUBLIC WATER SUPPLIES.
Thames Water Authority, London (England). Regional Lab. Services.
J. S. Colbourne, P. J. Dennis, R. M. Trew, C. Berry, and G. Vesey.
Water Science and Technology WSTED4, Vol. 20, No. 11/12, p 5-10, 1988. 7 tab, 22 ref.

Descriptors: *Human diseases, *Potable water, *Drinking water, *Pollutant identification, *Pathogens, *Legionella, *Public health, Bacterial analysis, Bacteria, Human pathogens, England.

A survey for Legionella in public water supplies in England failed to detect culturable L. pneumophila in all but samples from taps in buildings; however, the organism was detected in underground and surface water sources and distribution systems using an indirect immunofluorescent assay (IFA) to L. pneumophila serogroup 1. Culturability was related to temperatures above 20 C. In water mains, L. pneumophila was associated with biofilms or sediment. Non-culturable L. pneumophila detected in potable waters by IFA were recovered by heat shock experiments demonstrating their viability. Although the strain found in potable water is rarely associated with disease, monoclonal expression, a virulence marker, was altered by heat shock. These findings have implications for the prevention of legionellosis and may explain the sporadic nature of Legionnaires' disease in the community. (Author's abstract)
W89-11070

LEGIONNAIRES DISEASES AND THE WATER ENVIRONMENT IN ISRAEL.
Hebrew Univ. of Jerusalem (Israel). Human Environment Sciences Div.
For primary bibliographic entry see Field 5B.
W89-11074

MULTIPLICATION OF A KLEBSIELLA PNEUMONIAE STRAIN IN WATER AT LOW CONCENTRATIONS OF SUBSTRATES.
Keuringsinstituut voor Waterleidingartikelen, Rijswijk (Netherlands).
van der Kooij, and W. A. M. Hijnen.
Water Science and Technology WSTED4, Vol. 20, No. 11/12, p 117-123, 1988. 3 fig, 2 tab, 16 ref.

Descriptors: *Nutrient requirements, *Bioindicators, *Klebsiella, *Water treatment facilities, *Population dynamics, Water analysis, Substrates, Path of pollutants, Bacterial analysis, Bacteria, Water treatment, Carbohydrates, Microorganisms.

A K. pneumoniae strain, isolated from a water treatment system, was tested in growth measurements for its ability to multiply at substrate concentrations of a few micrograms per liter. The organism multiplied on mixtures of carbohydrates and amino acids at a substrate concentration of 1 microgram of C of each compound per liter. Tests with individual compounds revealed that carbohydrates in particular were utilized at low concentrations. The K sub s values obtained for maltose and maltopentaose were 53 micrograms of C/l and 114 micrograms of C/l, respectively. The results indicated the K. pneumoniae are able to utilize a variety of substrates at a concentration of only a few micrograms/l. A number of carbohydrates are preferred substrates for this organism. Thus, introduction of these bacteria into drinking water may cause coliform positive drinking water samples either as a result of the survival of these bacteria or even growth when sufficient substrate is available. (Friedmann-PTT)
W89-11085

TOXICITY TESTING IN WASTEWATER SYSTEMS: APPLICATION OF A SHORT-TERM ASSAY BASED ON INDUCTION OF THE LAC OPERON IN E. COLI.
Florida Univ., Gainesville. Dept. of Environmental Engineering Sciences.
B. Koopman, G. Bitton, R. J. Dutton, and C. L. Logue.
Water Science and Technology WSTED4, Vol. 20, No. 11/12, p 137-143, 1988. 15 ref. NSF Grant CES-8619073.

Descriptors: *Bacterial physiology, *Toxicity, *Bioassay, *Escherichia coli, *Wastewater treatment, *Wastewater facilities, *Pollutant identification, Bacteria, Sensitivity analysis, Municipal wastewater, Enzymes, Daphnia, Microbial toxicity assay.

A microbial toxicity assay based on inhibition of beta-galactosidase biosynthesis in Escherichia coli was evaluated for toxicity screening in a large municipal wastewater system. Beta-galactosidase biosynthesis in a wild type E. coli strain was less sensitive than Daphnia pulex to toxic wastewater samples. Assay sensitivity was improved by employing a mutant bacterial strain that was permeable to hydrophobic compounds. Further increase in sensitivity was obtained by pretreating the mutant with Polymyxin B. The modified assay compared well to D. pulex bioassay but was less sensitive to some samples than Microtox. (Author's abstract)
W89-11088

FUNGI FROM POTABLE WATER: INTERACTION WITH CHLORINE AND ENGINEERING EFFECTS.
West Chester Univ. of Pennsylvania. Dept. of Biology.
W. D. Rosenzweig, and W. O. Pipes.
Water Science and Technology WSTED4, Vol. 20, No. 11/12, p 153-159, 1988. 7 tab, 9 ref. NSF Grant ECE-8515710.

Descriptors: *Water treatment, *Fungi, *Potable water, *Water pollution sources, *Chlorination, *Disinfection, *Water quality control, Drinking water, Water supply, Storage tanks, Municipal water, Sampling, Water conveyance, Water pollution effects, Path of pollutants.

In recent years, various types of imperfect fungi have been isolated from water systems. Fungal spores and mycelia can be inactivated by low concentrations of chlorine in the laboratory but survive in some habitats in water distribution systems. A field study was conducted that provided evidence that some types of fungi are able to grow in water distribution systems. Replicate samples from private residences were used to demonstrate that fungal densities are sometimes much greater than the levels that could be explained by adventitious spores. Distribution system samples were obtained from residential taps and, in some cases, from fire hydrants and elevated storage tanks. Four replicate samples were obtained at each site for the groundwater systems and 8 replicate samples were obtained at each site in the surface water systems. Replicate sampling was essential to demonstrate the variations in fungal densities in the water systems. Fungi were isolated by the membrane filter procedure. The samples from the storage tank has a significantly higher average fungus count than the samples from private residence and a higher fraction of samples with fungi present although that difference was not significant. The fungus content of water samples collected from fire hydrants was significantly different from the fungus content of water samples collected from private residences in the same block. The fungus responsible for the one sample set with many fungi from the residences was a Cladosporium, while the fungi from the three sample sets with many strains from the storage tank were a Penicillium and a Phialophia, neither of which were seen in residential samples; fungi in the sample sets from hydrants were predominantly Penicillium and Rhodotorula. Elevated storage tanks open to the atmosphere appear to be significant sources of fungal input to some systems. (Friedmann-PTT)
W89-11090

INSTRUMENTAL DETECTION OF COLIFORM BACTERIA FOR INDUSTRIAL CONTROL OF DRINKING WATER QUALITY.
Societe Generale pour l'Agriculture, Rueil-Malmaison (France).
C. Bernard, J. P. Leglise, F. Colin, and J. Bouchinet.
Water Science and Technology WSTED4, Vol. 20, No. 11/12, p 185-191, 1988. 4 fig.

Descriptors: *Measuring instruments, *Pollutant identification, *Water quality control, *Drinking water, *Coliforms, *Human pathogens, Potable water, Bacteria, Microorganisms, Water analysis, Bacterial analysis, Comparison studies, Pathogens, Escherichia coli, Performance evaluation, Process control, Quantitative analysis.

Ensuring the sanitary quality of the potable water supply requires continuous control. Traditionally, germs indicating fecal contamination are detected as it is difficult of isolate and enumerate the pathogenic organisms. An on-site locatable automatic device 'E. colimeter' was developed. This device can detect one thermoresistant bacterium with a response time below 10 h. A multiple cell multiple channel testing unit was used. Metrohm EA 880-220 measuring cells were used, with a 200 ml total volume. For measurement, a 6-channel potentiometric recorder was used. The first test were carried out using the LTB medium on the E. coli strain. Several tests were performed using pure cultures to verify Wilkins' method. To evaluate the device, a comparison was carried out between the response given by the device and that deduced from the visual interpretation of the potential (time) curve recorded from the same cell. Overall, the automatic device provided a diagnosis very close to that of an operator interpreting the results of cells run manually under the same conditions. The tests thus confirmed the semi-quantitative nature of the device, with an error in half of the cases smaller than 1 power of 10 in terms of count, and in the other half in the order of 1 to 2 powers of 10, which is highly compatible with the alarm and monitoring functions assigned to the device. (Friedmann-PTT)
W89-11095

MONOCLONAL ANTIBODY BASED IMMUNOFLUORESCENT ASSAY FOR GIARDIA AND CRYPTOSPORIDIUM DETECTION IN WATER SAMPLES.
Nevada Univ., Las Vegas. Environmental Research Center.
L. D. Stetzenbach, M. J. Arrowood, M. M. Marshall, and C. R. Sterling.
Water Science and Technology WSTED4, Vol. 20, No. 11/12, p 193-198, 1988. 2 tab, 11 ref.

Descriptors: *Bioassay, *Giardia, *Cryptosporidium, *Pollutant identification, *Parasites, *Human pathogens, Quantitative analysis, Microorganisms, Sampling, Water quality control, Path of pollutants, Fluorescence, Protozoa.

Cryptosporidium and Giardia are enteric dwelling parasites that cause diarrheal illness. These parasites are present in numerous animal species and the potential zoonotic transmission to man via water is of increasing concern. Water samples collected from recreational sites throughout the state of Arizona were assayed for the presence of Giardia cysts and Cryptosporidium oocysts using a qualitative presence/absence immunofluorescent assay with cell wall specific monoclonal antibodies developed in the laboratory. Seven percent of the water samples were positive for Giardia cysts while 30% were positive for Cryptosporidium oocysts. In addition, a quantitative assay was performed on each water sample for Cryptosporidium oocysts. The presence/absence qualitative immunofluorescent assay method proved to be a more efficient, sensitive and reliable means to detect these parasites in surface waters. (Author's abstract)
W89-11096

HEPATITIS A VIRUS LEVELS IN SHELLFISH EXPOSED IN A NATURAL MARINE ENVIRONMENT TO THE EFFLUENT FROM A TREATED SEWAGE OUTFALL.
Centre d'Etudes et de Recherches de Biologie et d'Oceanographie Medicale, Nice (France).
C. Pietri, B. Hugues, J. M. Crance, D. Puel, and C. Cini.
Water Science and Technology WSTED4, Vol. 20, No. 11/12, p 229-234, 1988. 2 fig, 2 tab, 20 ref.

Descriptors: *Human diseases, *Marine environment, *Pollutant identification, *Hepatitus virus, *Mussels, *Oysters, *Water pollution effects, *Shellfish, *Population exposure, *Viruses, *Wastewater outfall, Sampling, Seawater, Effluents, Sampling.

Hepatitis A virus (HAV) contamination studies and cell-culturable virus determination were undertaken on oysters (Crassostrea angulata) and mussels (Mytilus edulis) kept for six months in the sea near the outfall of a sewage treatment plant. Shellfish and seawater samples were collected on 11 occasions at roughly 15-d intervals during this period. A radioimmunoassay revealed HAV contamination indices (P/N > or = 2.1) in 3 oyster and 6 mussel samples and 1 seawater sample. When a radiocompetition test was run on these samples, however, specificity was noted in one mussel sample only (P/N = 2.4). Immune electron microscopy showed that HAV particles were present in three effluent samples. Although a frequent demonstration at sometimes high concentrations (326.0 MPNCU/100 ml) in the effluent was observed, no cell-culturable virus were detected in both the shellfish and the seawater. Adenovirus alone were detected in one mussel sample, but not in the effluent. Complementary studies are now being conducted on all samples with an RIA HAV contamination index of P/N > or = 2.1. The results of this investigation of viral contamination in a natural marine environment and the HAV detection assays underscore the difficulty in determining the true extent of these phenomena. (Author's abstract)
W89-11101

INTERACTIONS BETWEEN FREE-LIVING AMOEBAE AND LEGIONELLA IN THE ENVIRONMENT.
Strasbourg-1 Univ. (France). Faculte de Pharmacie.
C. Harf, and H. Monteil.
Water Science and Technology WSTED4, Vol. 20, No. 11/12, p 235-239, 1988. 1 tab, 28 ref.

Descriptors: *Protozoa, *Pollutant identification, *Legionella, *Microorganisms, *Path of pollutants, *Parasites, Aquatic habitats, Ecosystems, Bacteria, Growth media, Food chains, Culturing techniques, Natural waters, Sediments, Isolation, Survival, Mutation.

While their presence is common in the environment, culture and isolation of Legionella from environmental waters are fastidious. Free-living amoebae have identical aquatic habitats and are probable natural hosts for Legionella. In a laboratory investigation, it is shown that amoebae can feed on Legionella on solid and in liquid media; both survived on several subcultures of amoebae, including Acanthamoeba castellanii, A. polyphaga, Naegleria fowleri, N. australiensis, and N. lovaniensis. Amoebae were isolated from river waters and from sediments. Cysts or trophozoites were subcultured; the amoebae were then washed and harvested, then lysed by thermal shock and ultrasonic treatment. The lysates were positive for Legionella by IFD with different pools of antisera (A, B and C from Centers for Disease Control, Atlanta). Intra-peritoneal injection of the lysates into guinea pigs allowed the isolation of L. pneumophila 1 from blood and various organs. These results suggest that amoebae are likely to be natural hosts for Legionella and are convenient as an ecological model in the laboratory. Intracellular replication and inclusion in resistant cysts of amoebae give them a possibility of survival in unfavorable conditions. Legionellosis might be the result of an accidental event caused by man in the natural cycle of an aquatic bacteria usually developing in amoebae. (Friedmann-PTT)
W89-11102

CORRELATIONS OF THE PROTOZOA, CRYPTOSPORIDIUM AND GIARDIA, WITH WATER QUALITY VARIABLES IN A WATERSHED.
Arizona Univ., Tucson. Dept. of Microbiology and Immunology.
For primary bibliographic entry see Field 5B.
W89-11107

COMPARATIVE STUDIES ON THE SURVIVAL OF INDICATOR ORGANISMS AND PATHOGENS IN FRESH AND SEA WATER.
Newcastle upon Tyne Univ. (England). Dept. of Civil Engineering.
For primary bibliographic entry see Field 5B.
W89-11112

EVALUATION OF MICROBIAL DETECTION METHODS AND INTERLABORATORY COMPARISONS DURING A PEROXIDE-NUTRIENT ENHANCED IN SITU BIORECLAMATION.
Du Pont de Nemours (E.I.) and Co., Wilmington, DE. Chemicals and Pigments Dept.
C. D. Litchfield, C. W. Erkenbrecher, C. E. Matson, L. S. Fish, and A. Levine.
Water Science and Technology WSTED4, Vol. 20, No. 11/12, p 317-322, 1988. 2 fig, 1 tab, 15 ref.

Descriptors: *Water pollution treatment, *Pollutant identification, *Water pollution control, *Municipal water, *Microbial degradation, *Cleanup operations, *Gasoline, Biomass, Bioindicators, Microorganisms, Groundwater pollution, Hydrocarbons, Performance evaluation, Comparison studies, Adenosine triphosphate, Biodegradation, Reclaimed water.

A borough water supply was endangered when approximately 1000 gallons of leaded gasoline leaked from an underground storage tank. After free product recovery was completed, an in situ bioreclamation program was started. The changes in microbial numbers during nutrient addition are documented by evaluating adenosine triphosphate (ATP), plate counting, and the acridine orange direct counting (AODC) method. An interlaboratory evaluation of microbial detection by culture techniques was also conducted. The plate count

data on similar media were the same for the two laboratories. An incubation period of at least 7, and preferably 14 days is necessary. The lack of correlation of ATP with other biomass indicators may reflect unknown stresses on the microbial community and not that ATP cannot be used as a biomass indicator. Finally, AODC in these samples was 1 to 2 orders of magnitude higher than CFU, but was also frequently lower than the CFU on nutrient agar incubated for 14 days. Of the procedures tested, plate counts on nutrient agar are a good indicator of the progress of an in situ bioremediation of a petroleum hydrocarbon spill. (Friedmann-PTT)
W89-11113

F-SPECIFIC RNA-BACTERIOPHAGES AS MODEL VIRUSES IN WATER HYGIENE: ECOLOGICAL ASPECTS.
Rijksinstituut voor de Volksgezondheid en Milieuhygiene, Bilthoven (Netherlands). Lab. for Water and Food Microbiology.
A. H. Havelaar, and W. M. Pot-Hogeboom.
Water Science and Technology WSTED4, Vol. 20, No. 11/12, p 399-407, 1988. 4 tab, 33 ref.

Descriptors: *Bioindicators, *Water treatment, *Farm wastes, *Viruses, *Pathogens, *Pollutant identification, Microorganisms, Parasites, Feces, Bacteria, Microenvironment, Model studies.

Model organisms can be used to detect the possible presence of pathogens (index-function) or to assess the performance of a treatment process (indicator-function). To evaluate the index-function of FRNA-phages, their ecology was studied. These phages were shown to be absent from feces of humans, dogs, cows, horses and to occur in relatively low numbers only in the feces of pigs and calves. High counts were obtained from feces of broiler chickens (1,000-10,000,000 pfu/g). In various types of wastewater, counts were usually between 1,000 and 10,000 pfu/ml. These high counts could not be explained by direct fecal input. Multiplication of FRNA-phages in the environment seemed unlikely because of the necessity of bacterial host-strains to bear F-pili. These are only produced at temperatures above 30 C. It was shown, however, that multiplication of FRNA-phages can also occur if a host-cell pregrown at 37 C (e.g. in the warm-blooded intestine) is transferred to environmental temperatures. Hence, the presence of FRNA-phages in environmental samples is indirectly associated with fecal pollution. (Author's abstract)
W89-11124

APPLICATION OF MICROTITRATION TECHNIQUE FOR MOST PROBABLE NUMBER ESTIMATION OF BACTERIA.
Technische Univ. Berlin (Germany, F.R.). Dept. of Hygiene.
T. G. Weisswange, and W. Dott.
Water Science and Technology WSTED4, Vol. 20, No. 11/12, p 417-420, 1988. 2 fig, 3 tab, 5 ref.

Descriptors: *Chemical precipitation, *Most probable number test, *Computer programs, *Pollutant identification, *Bacteria, *Bacterial analysis, Water analysis, Probabilistic process, Statistical methods, Microorganisms, Mathematical studies, Precision, Estimating, Automation.

A computer program used to estimate the most probable number of bacteria in a suspension is presented. For traditional most probable number (MPN) tables, values can be found for a dilution factor of 2 or 10 and 3, 5 or 10 replicates in each dilution step only; in some tables, these values are given for 90 percent or 95 percent confidence limits, which should give information on the accuracy of a single test. With the improved method, dilution and inoculation steps are automated so that a simultaneous inoculation of 96 tubes can be made within seconds. With a commercial scanning system and the computer program, a large number of scanning data can be processed into test results with little personnel or material expenditure. With the formula of Cochran, similar theoretical confidence limits were obtained at a dilution factor of v = 150 and 12 replicates that coincide with the Standard Method v = 10 and p = 5 (F = 3.3), where the confidence range is spread over a power of ten. To validate this formula, 64 tests were made in a microsystem with 12 replicates each and dilution factor v = 150, to estimate the MPN of two suspensions. In the first suspension, 10 (16 percent) of values were out of confidence limits, but in the second test, only 2 values were out of limits. The advantages of an automated MPN estimation are reduction of the handling error, increase in accuracy, and time and material savings. (Freidmann-PTT)
W89-11126

RAPID NITROCELLULOSE ENZYME IMMUNOSORBENT ASSAY TECHNIQUE (NC-EIA) FOR MONITORING VIRUSES IN THE ENVIRONMENT,
Hawaii Univ., Honolulu. Dept. of Microbiology.
M. A. Dow, P. C. Loh, and R. S. Fujioka.
Water Science and Technology WSTED4, Vol. 20, No. 11/12, p 421-423, 1988. 2 fig, 2 tab, 3 ref.

Descriptors: *Immunoassay, *Enzymes, *Nitrocellulose, *Pollutant identification, *Monitoring, *Viruses, *Potable water, Water quality control, Pathogens, Water analysis, Polioviruses, Microfiltration, Detection limits, Proteins, Monitoring, Assay.

The nitrocellulose enzyme immunoassay (NC-EIA) method was developed and optimized as a practical and rapid means of analyzing potable waters for the presence of viruses. Polioviruses types 1 and 2 were used; the enzyme immunossay was used on electropositive-filtered tap water, and was made from rabbit antibody, anti-rabbit biotinylated sera and streptavidin-horseradish peroxidase. The chromogen was 4-chlor-1-napthol. The NC-EIA procedure used the Bio-Rad microfiltration apparatus. Amplification of NC-EIA using Biotin-AB and SA-HRP enable detection of polioviruses in PBS to be at least ten times more sensitive by using the streptavidin-biotin procedure. The assay detected viruses in all three eluents that were tested. Initial experiments also indicated that the beef extract eluents were superior to glycine for elution of virus from filters. The sensitivity to the viral protein in the concentrates was 10,000-100,000 PFU, which represented 6-30 ng of protein. These results show that the NC-EIA can regularly detect nanogram amounts of viral antigen in water sample concentrates, and will be able to augment current infectivity assay methodology. (Friedmann-PTT)
W89-11127

APPLYING BACTERIOLOGICAL PARAMETERS FOR EVALUATING UNDERGROUND WATER QUALITY.
National Research Centre, Cairo (Egypt). Water Pollution Control Lab.
H. T. El-Zanafaly, and A. M. Shabaan.
Water Science and Technology WSTED4, Vol. 20, No. 11/12, p 425-428, 1988. 1 tab, 28 ref.

Descriptors: *Groundwater quality, *Water quality control, *Water treatment, *Drinking water, *Bacterial analysis, Coliforms, Test wells, Groundwater pollution, Sampling, Bacteria, Water analysis, Anaerobic bacteria, Groundwater, Well water, Streptococcus, Pollutant identification, Water quality.

A total of 111 water samples were drawn from 15 wells were subjected to bacteriological examination to determine the suitability of the monitored wells as a source of drinking water. Significant levels of bacterial pollution indicators were detected in the underground water samples during the period of study. Total bacterial counts ranged between 10-10,000 CFU/ml. Fecal streptococci were the most common and detected in 96 percent of water samples. Lower percentages of samples (92.55 and 45 percent) were contaminate with total coliforms, fecal coliforms and total clostridia, respectively. For fecal coliforms, fecal streptococci were less than 0.7 in 86% of the examined samples. Anaerobic bacteria were detected in the examined well water samples. Only 101 water samples were tested for anaerobic spore-formers and all showed positive results. Most examined wells did not meet the water quality standards for drinking water. Accordingly, the necessity of controlling bacterial pollution in groundwater through disinfection was clearly confirmed. Testing the underground water for more than one indicator represents an important approach for water quality assurance. (Author's abstract)
W89-11128

PHENOTYPE VARIATION WITHIN KLEBSIELLA PNEUMONIAE: A TOOL TO TRACE SOURCES OF CONTAMINATION IN SURFACE WATER.
National Bacteriological Lab., Stockholm (Sweden).
T. A. Stenstrom, and I. Kuhn.
Water Science and Technology WSTED4, Vol. 20, No. 11/12, p 429-431, 1988. 2 tab, 3 ref.

Descriptors: *Bioindicators, *Environmental tracers, *Klebsiella, *Water pollution sources, *Path of pollutants, *Bacterial analysis, Water analysis, Coliforms, Streptococcus, Microorganisms, Pathogens, Water quality, Pollutant identification, Sweden, Biochemical tests, Computers, Raw water, Surface water.

Different sources of contamination with Klebsiella pneumoniae were separated in a river system in Sweden, with the aid of a computerized biotyping system, to study the relative proportion of dominating biotypes along the river and in the raw water intake to a major city. Water samples were taken from 29 points along the river Gota alv; bacteriological analyses were made for total and fecal coliforms, fecal streptococci and coliphages, and 5 to 10 colonies were randomly isolated from each sample based on Vp, Indole and Citrate reactions. Isolates giving a positive-positive reaction were further analyzed in the phenoplate system. The phenoplate system was used for biochemical fingerprinting; 48 tests giving a high degree of discrimination among strains of Klebsiella were selected. The sum of the test results for each reaction was calculated based on the four separate readings, and were compared pair-wise for all tested strains. From the river, a total number of 270 Klebsiella isolates were phenotyped. The isolates fell into 80 different groups, dominated by two groups: C01 and C02. Ten more phenotypes with between 2 and 11 isolates were found. The relative proportion of K. pneumoniae from the industrial raw water was in the range of 25 to 40 percent of the fecal coliform count. When sudden high concentrations occurred, these were nearly always dominated by the specific biotypes of Klebsiella from the industry. Although the fecal coliforms count in many instances gives a clear hygienic indication, a dominance of environmental strains of mainly Klebsiella may lead to false risk-assessments. Biotyping was proven in this study to be a valuable tool for tracing pollution source and testing the relative impact of a specific pollutant. (Friedmann-PTT)
W89-11129

LONG-TERM STUDY OF OCCURRENCE, DISTRIBUTION AND REDUCTION OF CAMPYLOBACTER SP. IN THE SEWAGE SYSTEM AND WASTEWATER TREATMENT PLANT OF A BIG TOWN.
Kiel Univ. (Germany, F.R.). Abt. Hygiene, Sozialhygiene und Gesundheitswesen.
For primary bibliographic entry see Field 5D.
W89-11154

GROUND WATER MONITORING FOR TEMIK (ALDICARB) IN FLORIDA.
Florida Univ., Gainesville. Dept. of Environmental Engineering Sciences.
W. L. Miller, J. A. Foran, W. Huber, J. M. Davidson, and H. A. Moye.
Water Resources Bulletin WARBAQ, Vol. 25, No. 1, p 79-86, February 1989. 4 fig, 2 tab, 11 ref.

Descriptors: *Water pollution sources, *Groundwater pollution, *Drinking water, *Monitoring,

*Insecticides, *Aldicarb, Wells, Ethylene dibromide, Potable water, Florida.

Over 700 community drinking water supplies were sampled for the pesticide Temik (aldicarb and its oxidative metabolites aldicarb sulfoxide and aldicarb sulfone) in Florida. All community wells sampled were located in counties where Temik was reported to have been used and approximately one-half of the wells were located in counties where groundwater was determined to be highly susceptible to contamination by Temik. Susceptibility was determined using ranking criteria that incorporated groundwater recharge characteristics, water use, and Temik use patterns. Temik was not detected in any of the community supply wells sampled during the study. However, it was detected in shallow, private wells, as was the pesticide ethylene dibromide in counties with groundwater characterized as highly susceptible to contamination. (Author's abstract)
W89-11163

DETERMINATION OF SEDIMENT COMPOSITION AND CHRONOLOGY AS A TOOL FOR ENVIRONMENTAL IMPACT INVESTIGATIONS.
Consiglio Nazionale delle Ricerche, Padua (Italy). Ist. di Chimica e Tecnologia dei Radioelementi.
G. A. Battiston, S. Degetto, R. Gerbasi, and G. Sbrignadello.
Marine Chemistry MRCHBD, Vol. 26, No. 2, p 91-100, March 1989. 5 fig, 7 ref.

Descriptors: *Pollutant identification, *Sedimentology, *Environmental impact statement, *Lagoons, *Organic matter, *Metals, Sediments, Marine sediments, Water pollution sources, Water quality, Water pollution, Radioactive dating, Heavy metals, Trace elements, Venice, Italy, X-ray fluorescence, Lead radioisotopes, Cesium radioisotopes.

The study of marine sediments represents a useful tool for determining the actual state of environmental pollution and for understanding the origin and mechanism of the phenomena. Sediments provide both a record of the past climatic and geological events and an indication of the activities of man in the surrounding watershed. Under ideal conditions where almost no physical and biological disturbances have occurred, sediments can be an invaluable historical record of environmental pollution. The establishment of detailed and accurate chronologies of sedimentation is required in order to calculate rates of sedimentation and elemental fluxes. One of the most useful methods of dating on a time scale of 100-200 years is by means of the natural isotope Pb210, followed by confirmation using the artificial isotope CS137. All the major constituents and many trace elements (Mg, Al, Si, S, Cl, K, Ca, Ti, Cr, Mn, Fe, Cu, Zn, Pb, Br, Rb, and Sr) were determined for three sediment cores from the lagoon of Venice, Italy by x-ray fluorescence spectrometry. The percentage of organic matter was also evaluated. The sedimentary horizons were dated by Pb210 and Cs137 techniques, fluxes to the sediment were calculated, and the anthropogenic origins of some heavy metals were considered on the basis of flux regression analysis. The lagoon of Venice has been moderately affected by anthropogenic Zn, Pb, and Cu, whereas no Cr enrichment was found. (Doria-PTT)
W89-11215

USE OF BIOMONITORING TO CONTROL TOXICS IN THE UNITED STATES.
Environmental Research Lab.-Duluth, MN.
N. A. Thomas.
Water Science and Technology WSTED4, Vol. 20, No. 10, p 101-108, 1988. 3 fig, 3 tab, 10 ref.

Descriptors: *Bioassay, *Monitoring, *Toxicity, *Water pollution control, Aquatic plants, Aquatic animals, Ecological effects, Leachates, Storm sewers, Rivers, Wastewater facilities, Pollutant identification.

A biomonitoring program has been developed to support the National Policy for the Development of Water Quality-Based Permit Limitations for Toxic Pollutants. The program focuses on the use of laboratory toxicity tests on aquatic plants and animals to predict ecosystem impact caused by toxic pollutants. Both acute and chronic toxicity tests were developed to test effluents and ambient waters. Laboratory and biological field studies were conducted at nine sites. Single species laboratory toxicity tests were found to be good predictors of impacts on the ecosystem when two or more species were used. Biomonitoring can be undertaken either on effluents and/or on the receiving waters. In that toxicity related to seeps, leachates and storm sewers has often been found upstream from dischargers, it is beneficial to conduct both effluent and ambient biomonitoring. (Author's abstract)
W89-11229

USE OF TOXICITY TESTS FOR ASSESSING THE EFFLUENT OF THE SOUTH PETROCHEMICAL COMPLEX TREATMENT SYSTEM.
SITEL, Triunfo (Brazil).
R. L. Teixeira, and E. S. Ferreira.
Water Science and Technology WSTED4, Vol. 20, No. 10, p 109-114, 1988. 1 fig, 5 tab, 9 ref.

Descriptors: *Wastewater treatment, *Chemical wastewater, *Bioassay, *Monitoring, *Toxicity, Tertiary wastewater treatment, Fish, Stabilization ponds, Water pollution effects, Wastewater analysis, Eggs, Larval growth stage, Behavior, Mortality, Brazil.

Sistema Integrado de Tratamento de Efluentes Liquidos (SITEL) is responsible for the treatment and disposal of wastewater generated by Polo Petroquimico do Sul, a petrochemical complex in southern Brazil. SITEL is composed of three stages of treatment: primary, secondary (activated sludge process), tertiary (eight connected stabilization ponds), and a final disposal system on land. SITEL has decided to expand its wastewater testing and environmental monitoring program to include bioassays. This action is necessary because physical and chemical data alone are not sufficient for the evaluation of treatment efficiencies and for the assessment of the potential effects of disposal practices on receiving water and associated biota. For this reason, an additional program including two short-term toxicity tests with eggs and larvae of Pimephales promelas was implemented. The first results obtained suggest good performance of the treatment system concerning reduction of toxicity. In the tertiary stage of treatment, the toxicity tests were shown to be more effective than physical and chemical analysis. (Author's abstract)
W89-11230

COMPARISON OF INSTRUMENTAL DEWATERING METHODS FOR THE SEPARATION AND CONCENTRATION OF SUSPENDED SEDIMENT FOR SUBSEQUENT TRACE ELEMENT ANALYSIS,
Geological Survey, Doraville, GA.
For primary bibliographic entry see Field 7B.
W89-11287

EXTRACTION AND ISOLATION OF TRIAZINE HERBICIDES FROM WATER AND VEGETABLES BY A DOUBLE TRAP TANDEM SYSTEM.
Universita degli Studi 'La Sapienza', Rome (Italy). Dipt. di Chemica.
M. Battista, A. DiCorcia, and M. Marchetti.
Analytical Chemistry ANCHEM, Vol. 61, No. 9, p 935-939, May 1, 1989. 3 fig, 3 tab, 22 ref.

Descriptors: *Water pollution, *Triazine pesticides, *Pesticides, *Pollutant identification, *Water analysis, *Separation techniques, *Herbicides, Vegetable crops, Trap systems, Carbon filters, Ion exchange, Chemical analysis.

The ability of a two-trap tandem system, one containing a nonspecific adsorbing material, such as graphatized carbon black (Carbopack B), and the other one filled with a sulfonic acid type silica-based cation exchanger (SCX), to extract and isolate basic compounds from real matrices was evaluated by applying this device to the determination of triazine residues in water and vegetables. After percolation through the Carbopack column (extraction cartridge) of water samples or suitability prepared vegetable extracts, the two traps were connected in series; a methylene chloride-methanol mixture was allowed to flow through them and triazines displaced from the extraction cartridge were selectively readsorbed via salt formation on the strong acid exchanger column (isolation cartridge). After the column was washed, the analytes were removed from the isolation cartridge by 0.7 ml of aqueous methanol containing 70 mmol/L KCl. After the internal standard was added, the final solution was directly injected into the high performance liquid chromatographic apparatus, which was operated isocratically in the reverse-phase mode with UV detection at 220 nm. The analytical recoveries of eight triazines from the two matrices considered ranged between 95% and 100%. The limits of sensitivity of this method for triazines were set at 10 ng/g of vegetable material and 10 ng/L of water by sampling 100 ml o fit. (Author's abstract)
W89-11300

MONITORING OF ACIDIFICATION BY THE USE OF AQUATIC ORGANISMS.
Bergen Univ. (Norway). Zoological Museum.
For primary bibliographic entry see Field 7B.
W89-11346

ANALYTICAL METHOD FOR BUTYLTIN SPECIES IN SHELLFISH,
Bowdoin Coll., Brunswick, ME. Hydrocarbon Research Center.
D. S. Page.
Marine Pollution Bulletin MPNBAZ, Vol. 20, No. 3, p 129-133, March 1989. 1 fig, 2 tab, 30 ref.

Descriptors: *Pesticides, *Organotins, *Pollutant identification, *Shellfish, Gas chromatography, Liquid chromatography, Organotin compounds, Separation techniques, Standards, Quantitative analysis.

A method for analyzing tributyltin (TBT) and dibutyltin (DBT) in shellfish is presented that places modest requirements on equipment and supplies. It is based on capillary gas chromatographic analysis of hexyl derivatives of organotin species and consists of a wet extraction of a spiked homogenate with methylene chloride. This is followed by treatment with hexyl magnesium bromide to form the hexyl derivatives of any extractable organotin species present. These tetra-alkyltins have low volatilities and separate well in the gas chromatograph. The resulting derivatized extract is cleaned up by liquid chromatography on silica gel followed by concentration and quantitation using capillary GC. Ordinarily, three sets of duplicate samples are analyzed at a given time. If the results for a given duplicate are not sufficiently precise, then a second duplicate from the remaining homogenate is analyzed. Two internal standards are used. Data are presented showing that the precision and accuracy of the method are generally better than +or- 20%. The analysis provides useful means for making an assessment of TBT inputs. This analytical method while labor-intensive and requiring some synthetic skill in setting up, provides good precision and accuracy with relatively unsophisticated instrumentation. (Miller-PTT)
W89-11386

INVESTIGATIONS OF 'PETROLEUM HYDROCARBONS' IN SEAWATER, USING HIGH PERFORMANCE LIQUID CHROMATOGRAPHY WITH FLUORESCENCE DETECTION.
Deutsches Hydrographisches Inst., Hamburg (Germany, F.R.).
N. Theobald.
Marine Pollution Bulletin MPNBAZ, Vol. 20, No. 3, p 134-140, March 1989. 5 fig, 1 tab, 10 ref.

Descriptors: *Oil pollution, *Pollutant identification, *Hydrocarbons, *Liquid chromatography, *Seawater, *Fluorescence, Ultraviolet analysis, North Sea, Baltic Sea, Atlantic Ocean.

A high performance liquid chromatographic (HPLC) separation on a reversed phase C18 column has been developed for the analysis of petroleum hydrocarbons. Water extracts from the North Sea, Baltic Sea and North Atlantic, representing different degrees of pollution, were investigated by classical ultraviolet fluorescence spectroscopy and HPLC with fluorescence detection. The HPLC method proved to be simple, sensitive, and rugged enough to be used on board a ship. The chromatographic analysis yields far more information about the water samples than the spectroscopic analysis alone. It could be shown that a great part (50-90%) of the fluorescence, generally referred to as petroleum hydrocarbons, is caused by non-hydrocarbonic, polar compounds. (Author's abstract)
W89-11387

BIOLOGICAL ASSESSMENT OF THE WATER QUALITY IN SOUTH-HOLLAND (THE NETHERLANDS).
Hoogheemraadschap van Rijnland, Leiden (Netherlands).
For primary bibliographic entry see Field 7B.
W89-11390

MULTIELEMENT PRECONCENTRATRION OF TRACE METALS FROM NATURAL WATERS BY SOLVENT EXTRACTION WITH AN ALKYLATED OXINE DERIVATIVE.
McMaster Univ., Hamilton (Ontario). Dept. of Chemistry.
V. Pavski, A. Corsini, and S. Landsberger.
Talanta TLNTA2, Vol. 36, No. 3, p 367-372, March 1989. 5 tab, 30 ref.

Descriptors: *Water analysis, *Pollutant identification, *Trace metals, *Natural waters, Separation techniques, Kelex, Seawater, Isotope studies, Hydrogen ion concentration, Chelation, Atomic absorption spectrophotometry, Calibrations.

The potential of a proprietary alkylated derivative of oxine (8-quinolinol), 7-(4-ethyl-1-methyloctyl)-8-quinolinol (HL), the active component of Kelex 100, was investigated as a good extractant for environmentally significant trace metals in natural waters. In addition to possessing unselective complex-forming characteristics similar to those of its parent compound, the enhanced lipophilicity of HL relative to oxine should make higher distribution ratios attainable. The efficiency of HL in toluene for extraction of nine trace metals from artificial and natural seawater as well as natural lake water matrices, has been studied with radioisotopes, as a function of pH. The optimized preconcentration procedure has been applied to the seawater reference material, CASS-1. Kelex-100, a commercially available alkylated derivative, is shown to be effective in purified form for the simultaneous extraction of trace levels of Cd(II), Co(II), (Cu(II), Mn(II), Ni(II), Pb(II), and Zn(II) from natural waters into toluene. The high lipophilicity of the extractants and its chelates affords large preconcentration factors in a single batch-extraction. Back-extraction with a small volume of nitric acid provides additional enrichment for subsequent determination of total (soluble) metal by graphite-furnace atomic absorption spectrometry. Calibration with standard solutions can be used, which has advantages over the method of standard additions. (Miller-PTT)
W89-11394

TRACE METAL CONTENTS IN CERTIFIED REFERENCE SEDIMENTS DETERMINED BY NITRIC ACID DIGESTION AND ATOMIC ABSORPTION SPECTROMETRY.
National Inst. of Oceanography, Haifa (Israel).
B. S. Krumgalz, and G. Fainshtein.
Analytica Chimica Acta ACACAM, Vol. 218, No. 2, p 335-340, March 1989. 2 tab, 18 ref.

Descriptors: *Trace metals, *Cadmium, *Copper, *Lead, *Zinc, *Iron, *Pollutant identification, Separation techniques, Heavy metals, Leaching, Atomic absorption spectrophotometry, Marine sediments, Fluvial sediments.

The trace metal (cadmium, copper, lead, zinc, iron) contents of certified reference sediments (BCSS-1, MESS-1, SRM 1645 river sediments and SRM 1646 estuarine sediment) were determined by nitric acid digestion at 140 C without silicate lattice dissolution. All the metals studied except iron were completely recovered by this digestion method as shown by atomic absorption spectrophotometry. About 20% of the iron was incorporated into the silicate lattice and was not dissolved by the nitric acid digestion. The certified values for iron can be used only for procedures involving complete sediment dissolution. The trace metal contents in SRM 1645 were also examined by using the hydroxylammonium chloride/acetic acid leaching procedure. The results show that this extraction method recovers only different portions of the trace metals bound to various phases of a particulate sediment. (Geiger-PTT)
W89-11402

SPECIATION OF COPPER IN FRESH WATERS.
Nagoya Univ. (Japan). Faculty of Engineering.
T. Miwa, M. Murakami, and A. Mizuike.
Analytica Chimica Acta ACACAM, Vol. 219, No. 1, p 1-8, April 1989. 3 fig, 4 tab, 10 ref.

Descriptors: *Water chemistry, *Speciation, *Pollutant identification, *Water analysis, *Copper, *Particulate matter, *Sorption, Rivers, Chelating agents, Ion exchange, Cations, Atomic absorption spectrophotometry.

The cations and readily dissociable complexes of copper were separated from copper adsorbed on inorganic and organic particulate species in river and pond waters by selective sorption on a strong-acid cation-exchange resin, AG50W-X12, and a chelating resin, Chelex-100, for graphite-furnace atomic absorption spectrometry. The sorption behavior after the pH change and removal of carbon dioxide suggests that the dominant low-molecular-weight copper species in river waters are neutral CuCO3 and Cu(++) ions for Chelex-100 and CuCO3 and Cu(++) for AG50W-X12. The microreticular resins AG50W-X12 and Chelex-100 absorbed none of the negatively charged colloidal aggregates prevalent in freshwaters (humic substances/hydrated iron (III) oxide/kaolin, hydrated iron (III) oxide/kaolin, and hydrated iron (III) oxide/silica). (Geiger-PTT)
W89-11403

IDENTIFICATION AND QUANTIFICATION OF P-CHLOROBENZENESULFONIC ACID IN GROUNDWATER.
National Enforcement Investigations Center, Denver, CO.
D. S. Kendall.
Analytica Chimica Acta ACACAM, Vol. 219, No. 1, p 165-169, April 1989. 1 tab, 8 ref.

Descriptors: *Water pollution sources, *Organic compounds, *Groundwater pollution, *Infrared spectroscopy, *Pollutant identification, Organic carbon, Chromatography, Hazardous waste disposal, Waste identification, Organic wastes, DDT.

Infrared spectra of various extracts were used to identify p-chlorobenzenesulfonic acid (a by-product of DDT production) in groundwater from the Stringfellow hazardous waste disposal site in Southern California. A reversed-phase ion-pair liquid chromatographic method was developed to quantify the compound. p-Chlorobenzenesulfonic acid was determined to be the predominant organic species in the groundwater, comprising as much as 50% of the organic carbon. Liquid chromatography gave accurate quantification, as shown by recoveries of spiked amounts, and good precision. For 15 laboratory and field samples containing 4.6-3200 milligrams/liter, relative standard deviations (n+3) ranged from 0.6% (at 3200 milligrams/liter) to 7.6% (at 1900 milligrams/liter) with an average value of 4.6 + or - 2.1%. (Geiger-PTT)
W89-11404

ELECTRON MICROPROBE INVESTIGATION OF THE CHEMISTRY OF FERROMANGANESE COATINGS ON FRESHWATER SEDIMENTS,
Cambridge Univ. (England). Dept. of Earth Sciences.
A. Buckley.
Geochimica et Cosmochimica Acta GCACAK, Vol. 53, No. 1, p 115-124, January 1989. 7 fig, 2 tab, 51 ref.

Descriptors: *Pollutant identification, *Water chemistry, *Geochemistry, *Manganese, *Iron, *Fluvial sediments, *Aluminum, Cobalt, Copper, Zinc, Barium, Cesium, Phosphorus, Lead, Interstitial water, Streams, Adsorption.

Manganese-iron coatings on clasts collected from a number of streams in the United Kingdom, draining a variety of lithologies, have been analyzed by electron microprobe. It was shown that Al, in addition to Mn and Fe, is a major constituent of such coatings, which are considered to be typical of those formed in freshwater systems. Little of the aluminum is held in alumino-silicates. The minor element content of the samples varies from site to site but the Mn-rich material shows an association of one or more of the elements Co, Cu, Zn, Ba and Ce. Similarly, P is associated with Fe-rich material. Evidence for the derivation of metals from multiple sources is provided by the bimodal major element/minor element ratios from individual sites and differing major element compositions of high Zn and high Ba samples from one site; demonstrating that both stream and pore waters made significant contributions to the minor element content of the coatings. These factors have also affected the Al content of the material. In addition to phases dominated by Mn, Fe and Al, distinct authigenic Pb-Mn and Zn-Mn phases were found at two lightly mineralized localities. The occurrence of such phases, needs to be evaluated in future sediment geochemical studies, especially work based on partial extraction techniques in geochemical exploration, pollution monitoring and sediment diagenesis. Similarly, the observed non-linearity of metal/Mn ratios may have an important bearing on such work. (Author's abstract)
W89-11406

DISSOLVED ORGANIC COPPER ISOLATED BY C18 REVERSE-PHASE EXTRACTION IN AN ANOXIC BASIN LOCATED IN THE PETTAQUAMSCUTT RIVER ESTUARY.
Rhode Island Univ., Narragansett. Graduate School of Oceanography.
G. L. Mills, G. S. Douglas, and J. G. Quinn.
Marine Chemistry MRCHBD, Vol. 26, No. 3,, p 277-288, April 1989. 4 fig, 1 tab, 23 ref. NSF Grant OCE-8200150. DOE Contract DE-AC09-76SR00-819.

Descriptors: *Water chemistry, *Geochemistry, *Estuaries, *Copper, *Dissolved solids, *Rhode Island, Particulate matter, Organic matter, High performance liquid chromatography, Sulfides, Reverse-phase extraction.

The upper region of the Pettaquamscutt River, Rhode Island, is a fjord-type estuary with two deep basins separated by a shallow sill. The water column in these basins remains stable for periods of several years with only partial mixing occurring. Dissolved organic copper isolated by C18 reverse-phase extraction was determined in the uppermost basin; these values ranged from 0.29 micrograms/kg in the oxic surface waters to <0.001 micrograms/kg in the deeper anoxic waters. Total dissolved and particulate copper concentrations ranged from 0.53 to 0.13 micrograms/kg and 0.46 to <0.03 micrograms/kg, respectively. Dissolved concentrations were highest at the surface while particulate copper values were greatest in the suboxic deeper waters. Organically bound copper accounted for 42-60% of the total dissolved copper in the oxic surface waters; however, these values progressively decreased to <1% through the redox transition zone. Chromatographic profiles of isolated dissolved organic matter were obtained using high-performance liquid chromatography. These profiles indicate that dissolved organic matter (DOM), which complexes copper in oxic waters, is present in the suboxic region. However,

binding of copper by this fraction of DOM is reduced or eliminated by competition with dissolved sulfide complexes. (Author's abstract)
W89-11426

EVALUATION OF HENRY'S CONSTANT FOR H2S IN WATER AND SEWAGE EFFLUENTS.
Kuwait Univ., Safat. Dept. of Chemical Engineering.
A. A. Al-Haddad, M. S. E. Abdo, and S. A. Abdul-Wahab.
Journal of Environmental Science and Health JESEDU, Vol. 24A, No. 3, p 207-227, April 1989. 4 fig, 4 tab, 13 ref.

Descriptors: *Henrys constant, *Hydrogen sulfide, *Wastewater treatment, *Temperature effects, Distilled water, Hydrogen ion concentration, Flow rates, Alkalinity.

An experimental set-up involving measurement of the H2S concentration in the gas phase while being stripped isothermically from solution at a known nitrogen gas flow rate was used to evaluate Henry's constant (H) of H2S in distilled water and one of the sewage treatment plants in Kuwait. H2S concentration in the gas phase was monitored using a Riken HS-7 gas detector fitted with digital read-out and printer which is designed to measure the presence of H2S in parts per million (volumetric ppm). Calculated values of (H) for H2S in distilled water were found to agree with published works. For sewage, (H) was found to have a mean value of 601 atm/mole fraction for a temperature range of 20 C to 40 C. Factors affecting the value of (H) in sewage were: initial concentration, flow rate of stripping fluid, pH, and pK. The rate of rise and decline in concentration of H2S in the gas phase for the sewage was much lower than that for the distilled water at all temperatures. At the same initial liquid concentrations of H2S, sewage samples exhibited lower H2S concentrations in the gas phase at high temperature compared to those with distilled water. This may be attributed to the alkalinity of sewage and its buffering capacity. The peak of H2S at 20 C was higher (12 ppm) compared to that at 30 C (10.5 ppm). The value of the peak at 40 C was 7.5 ppm which is much lower than those found at 20 and 30 C. (Geiger-PTT)
W89-11427

DETERMINATION OF PHENOLIC POLLUTANTS IN WATER USING PERMEATION SAMPLING.
Akron Univ., OH. Dept. of Chemistry.
G. Z. Zhang, and J. K. Hardy.
Journal of Environmental Science and Health JESEDU, Vol. 24A, No. 3, p 279-295, April 1989. 5 fig, 5 tab, 13 ref.

Descriptors: *Phenols, *Pollutant identification, *Gas chromatography, *Membrane processes, Monitoring, Permeability, Separation techniques, Desorption.

A passive sampling technique for the determination of time-weighted-average concentrations of phenolic priority pollutants in water is described. Phenols permeate a silicone polycarbonate membrane and are collected on a polymeric adsorbent. For high concentration ranges, phenols are adsorbed on the XAD-7 resin and then desorbed with acetonitrile. Low ppb concentrations of phenols are analyzed by collection on Tenax-TA followed by thermal desorption. Separation and quantification is achieved by capillary column gas chromatography using a flame ionization detector. A linear relationship between the amount of phenols collected and the products of the exposure time and phenolic concentrations over the range of 5 ppb-20 ppm have been determined. Temperature and solution pH affect permeation rates of the phenols. The sampling method is simple, inexpensive and suitable for multilocation monitoring. (Author's abstract)
W89-11430

CLONED RAINBOW TROUT LIVER P(1)450 COMPLEMENTARY DNA AS A POTENTIAL ENVIRONMENTAL MONITOR.
Medical Coll. of Wisconsin, Inc., Milwaukee. Dept. of Pharmacology and Toxicology.
M. L. Haasch, P. J. Wejksnora, J. J. Stegeman, and J. J. Lech.
Toxicology and Applied Pharmacology TXAPA9, Vol. 98, No. 2, p 362-368, April 1989. 1 fig, 1 tab, 35 ref. NIH Grant ES01080. Core Center Grant ES01985.

Descriptors: *Trout, *DNA, *Water pollution effects, *Monitoring, *Bioindicators, Liver, Water quality, RNA, Turtles, Reptiles, Rats.

A technique is proposed for the biological monitoring of pollutants in aquatic environments by use of a complementary DNA (cDNA) probe. The induction of hepatic cytochrome P(1)450 mRNA has been investigated utilizing pfP(1)450-3', a 3'-specific 1.5 kb cDNA clone derived from 3-methylcholanthrene-inducible mRNA of rainbow trout. A time course of induction of both the hybridizable mRNA and hepatic monooxygenase catalytic activity in rainbow trout with a known inducer in fish, beta-naphthoflavone, was studied. The cDNA probe was also shown to hybridize with induced mRNA of brook trout, scup, garter snake, painted turtle, and rat demonstrating the suitability of the probe for examining induction of mRNA in various species. The results of these experiments suggest that the cDNA probe may be useful as a biological monitoring tool for determining the presence and effects of chemical pollutants which are inducers of hepatic microsomal monooxygenase activity. The probe may have the potential to be applied as an early warning system in the monitoring of water quality. (Author's abstract)
W89-11431

DETERMINATION OF ORGANOPHOSPHOROUS COMPOUNDS AND CARBAMATES BY THEIR INHIBITION OF CHOLINESTERASE. PART 1: INHIBITION VALUES ON IMMOBILIZED CHOLINESTERASE (BESTIMMUNG VON PHOSPHORPESTIZIDEN UND INSEKTIZIDEN CARBAMATEN MITTELS CHOLINESTERASEHEMMUNG).
Technische Univ. Muenchen (Germany, F.R.). Inst. fuer Wasserchemie und Chemische Balneologie.
P. Herzspring, L. Weil, and K. E. Quentin.
Zeitschrift fuer Wasser-und Abwasser Forschung ZWABAQ, Vol. 22, No. 2, p 67-72, April 1989. 1 fig, 4 tab, 8 ref. English summary.

Descriptors: *Water analysis, *Pesticides, *Organophosphorus pesticides, *Carbamate pesticides, *Cholinesterase, *Insecticides, *Pollutant identification, Phosphates, Water pollution effects, Drinking water.

Twenty-two organophosphorus compounds and 12 carbamates were selected for determination of their inhibition values (rate constants ki) on immobilized acetylcholinesterase and butyrylcholinesterase. It was found that the inhibition values vary over a large range. Acetylcholinesterase is more strongly inhibited by dimethoxyorganophosphates and N-methylcarbamates than butyrylcholinesterase. On the other hand, diethoxyorganophosphates and N-dimethylcarbamates inhibit butyrylcholinesterase more strongly than acetylcholinesterase. If several insecticide compounds are present in water, the inhibition of cholinesterase is not a function of the sum of mass concentration of the individual compounds. It is only possible to determine the sum of inhibition as an equivalent of paraoxon. The German ordinance of drinking water 1989, on the other hand, proposes 500 ng/L as a limit for the sum of mass concentration of all pesticides in water. (Author's abstract)
W89-11434

BIOTEST TO DETERMINE HERBICIDES IN WATER: METHODS AND FIRST RESULTS (BIOTEST ALS SUMMENPARAMETER ZUR BESTIMMUNG VON HERBIZIDEN IM WASSER: METHODISCHE GRUNDLAGEN).
Technische Univ. Muenchen (Germany, F.R.). Inst. fuer Wasserchemie und Chemische Balneologie.
G. M. Zimmermann, L. Weil, P. Herzsprung, and K. E. Quentin.
Zeitschrift fuer Wasser-und Abwasser Forschung ZWABAQ, Vol. 22, No. 2, p 73-77, April 1989. 5 fig, 2 tab, 15 ref. English summary.

Descriptors: *Pesticides, *Triazine pesticides, *Pollutant identification, *Photosynthesis, *Drinking water, *Water analysis, Bioassay, Herbicides.

The effect of herbicides in potable water on photosynthetic electron transport and on photosynthesis was tested using isolated chloroplasts of Spinacia oleracea (Spinat). The inhibitory molecule decreases the light-dependent oxygen evolution. Some triazine herbicides and some of water existent substances were tested. It is possible to determine atrazine in a concentration of 10 micrograms/liter without any enrichment, although an enrichment of 100 is possible. With this biotest it is possible to determine herbicides within the limits of compliance with the ordinance of drinking water. (Author's abstract)
W89-11435

ENZYME IMMUNOASSAYS FOR THE DETERMINATION OF PESTICIDES IN WATER (ENZYMINNUNOASSAYS ZUR BESTIMMUNG VON PFLANZENSCHUTZMITTELN IM WASSER).
Technische Univ. Muenchen, Freising (Germany, F.R.). Lehrstuhl fuer Botanik.
B. Hock.
Zeitschrift fuer Wasser-und Abwasser Forschung ZWABAQ, Vol. 22, No. 2, p 78-84, April 1989. 9 fig, 16 ref. English summary.

Descriptors: *Pesticides, *Enzymes, *Bioassay, *Drinking water, *Pollutant identification, Antibodies, Herbicides, Atrazine, Triazine pesticides, Water analysis, Sensitivity analysis.

The specificity of serological reactions and the affinity of antibodies to suitable ligands can be exploited in the area of drinking water analysis. Enzyme immunoassays are of special importance for the detection of pesticides, which at present, raise severe problems in the analysis of drinking water. The general principle of the immunoassay is explained and the applications of homogeneous and heterogeneous enzyme immunoassays are described. The critical factors for the construction of an enzyme immunoassay are examined. The affinity of antibodies to a pesticide, the applied concentrations of the antibody and the enzyme tracer determine the detection limit and the sensitivity of the assays. The specificity is assayed by the cross reactivities of analogues. The determination of atrazine is given as an example. The simple performance, the high number of assays per unit of time, and the relatively low costs justify the use of enzyme immunoassays in drinking water analysis. (Author's abstract)
W89-11436

BIOSENSORS FOR WATER AND WASTEWATER ANALYSIS (BIOSENSOREN ZUR ANALYTIK VON WASSER UND ABWASSER).
Gesellschaft fuer Biotechnologische Forschung m.b.H., Brunswick (Germany, F.R.).
R. Kindervater, and R. D. Schmid.
Zeitschrift fuer Wassr-und Abwasser Forschung ZWABAQ, Vol. 22, No. 2, p 84-90, April 1989. 7 fig, 7 tab, 49 ref. English summary.

Descriptors: *Bioindicators, *Bioassay, *Pesticides, *Pollutant identification, *Water analysis, Biochemical oxygen demand, Herbicides, Organic compounds, Wastewater analysis.

Biosensors (biomonitoring devices consisting of a biocatalytic entity closely linked to a transducer) have been widely described during the past two decades. However, examples for the application of biosensors to water and wastewater analysis are scarce. Recently, biosensor concepts have been introduced for: measurement of inorganic and organic environmental chemicals; for the determination of BOD; and for the detection of herbicides and mutagens. The latter use is reviewed for or-

ganophosphorus pesticides, carbamates, metals, organic compounds, and herbicides in drinking water. (Author's abstract)
W89-11437

DETECTABILITY OF ACID PRODUCING REACTIONS IN NATURAL CLOUDS.
Brookhaven National Lab., Upton, NY. Environmental Chemistry Div.
T. J. Kelly, S. E. Schwartz, and P. H. Daum.
Atmospheric Environment ATENBP, Vol. 23, No. 3, p 569-583, March 1989. 3 fig, 4 tab, 66 ref. U.S. Dept. of Energy Contract DE-AC02-76CH00016.

Descriptors: *Pollutant identification, *Clouds, *Acid rain, *Chemistry of precipitation, Precipitation, Sulfur dioxide, Nitrites, Oxidation, Sulfur, Nitrogen, Fog, Chemical reactions, Cloud liquid water.

Oxidation reactions of SO2 and NO2 in clouds are considered important atmospheric acid formation processes. Therefore, the feasibility of detecting the occurrence of these oxidation reactions in natural clouds by means of field measurements has been evaluated. This evaluation was performed by calculating the changes expected in reagent and product concentrations resulting from these reactions in representative cloud types, and comparing those changes with concentration differences detectable by available analytical methods in the context of typical atmospheric variability. Four in-cloud oxidation reactions are considered: aqueous-phase reactions of SO2 with O3 and H2O2, and gas-phase reactions of NO2 with OH radical and with O3, the latter leading to acid formation by reaction of N2O5 with cloud liquid water. The cloud types considered are fog, stratus cumulus and mountain lee wave. This evaluation indicates that oxidation of SO2 by H2O2 should be detectable in a wide variety of cloud conditions, but that oxidation of SO2 by O3 is unlikely to be detected by field measurements. Oxidation of NO2 may be detectable in fog and stratus clouds, which provide long in-cloud residence times. The results of this evaluation are consistent with the results of field studies which have attempted to observe the occurrence of acid producing reactions in natural clouds. Efforts to directly measure the decrease in reagents or increase in products in natural clouds have usually provided no evidence for reaction, and many studies have not included measurements of a sufficient number of species to confirm SO4(2-) and NO3(-), at estimated rates consistent with the reactions considered here. (White-Reimer-PTT)
W89-11451

ZOOPLANKTON BIOINDICATION SYSTEM FOR THE MATSALU BAY: A PROBABILISTIC APPROACH,
For primary bibliographic entry see Field 7B.
W89-11461

APPRAISAL OF THE EFFICACY OF PRE-ENRICHMENT FOR THE ISOLATION OF CAMPYLOBACTER JEJUNJI FROM WATER AND FOOD,
Area Public Health Lab., Exeter (England).
T. J. Humphrey.
Journal of Applied Bacteriology JABAA4, Vol. 66, No. 2, p 119-126, July 1988. 3 fig, 3 tab, 19 ref.

Descriptors: *Separation techniques, *Biological samples, *Pathogenic bacteria, *Contamination, *Campylobacter, *Food processing industry, Food-processing wastes, Human pathology, Isolation, Enrichment, Enteric bacteria, Toxicity, Culturing techniques.

Two wild type strains, B and F, of Campylobacter jejunji isolated from human cases of enteritis using established media and techniques, and which had been shown to differ in their response to high or low temperatures, were used in the experiments. In addition, samples of broiler chicken skin and scald tank water were obtained from a local chicken processing factory, and were either examined immediately or subjected to a series of treatments. Differences in growth patterns were analyzed, where appropriate, using paired t or chi-squared tests. Cells of C. jejuni exposed to heating or freezing were progressively less able to grow at 43 C, particularly on selective media. This influenced the recovery of damaged cells from naturally and artificially contaminated samples. With broth culture the isolation rate could be increased by pre-enrichment in basal or selective media at 37 C for 4 h. With membrane filtration or surface plating techniques the inclusion of agents that quench toxic derivatives of oxygen was more important. (White-Reimer-PTT)
W89-11464

DETERMINATION OF METHYL YELLOW, SUDAN I AND SUDAN II IN WATER BY HIGH PERFORMANCE LIQUID CHROMATOGRAPHY.
Fukuoka Environmental Research Center (Japan).
M. Nagase, Y. Osaki, and T. Matsueda.
Journal of Chromatography JOCRAM, Vol. 465, No. 2, p 434-437, March 1989. 1 tab, 5 ref.

Descriptors: *Carcinogens, *Dyes, *Pollutant identification, *Liquid chromatography, Solvents, Methyl yellow, Sudan I, Sudan II, Distillation, Extraction, Separation techniques, Condensers, Variation coefficient, Detection limits.

Methyl Yellow, Sudan I, and Sudan II are used as dyes in gasoline, shoe polish, special inks, and plastics. However, Methyl Yellow has been reported to be a carcinogen. If these dyes are present in the environment, they would be released slowly into river and sea waters, due to their limited solubility in water. Therefore, a microanalytical method is required to detect these dyes in environmental waters. First, an examination was conducted to establish the most suitable pH for distillation and the most suitable distillate volume. Constant recoveries were obtained for distillate volumes of 400-450 ml and pH ranges of 5-13 for Methyl Yellow, 1-11 for Sudan I, and 1-13 for Sudan II. The addition of 2-5 ml of hexane for extraction resulted in recoveries of over 90%. Over 90% of the residual dyes in the water-cooled condenser, the funnelled adapter and the measuring cylinder could be recovered by washing with 0-100 ml of acetone. Recoveries from river and sea waters were over 87.5% with coefficients of variation below 5%. The detection limits for a 500 ml water sample were 0.2 microg/L for Methyl Yellow and Sudan I and 0.3% microg/L for Sudan II. (White-Reimer-PTT)
W89-11469

SOLUTIONS TO PROBLEMS IN ENUMERATING SEDIMENT BACTERIA BY DIRECT COUNTS.
McGill Univ., Montreal (Quebec). Dept. of Biology.
M. Schallenberg, J. Kalff, and J. B. Rasmussen.
Applied and Environmental Microbiology AEMIDF, Vol. 55, No. 5, p 1214-1219, May 1989. 5 fig, 3 tab, 18 ref.

Descriptors: *Bacterial analysis, *Bacteria, *Sediments, Microbiological studies, Sampling, Turbidity, Organic matter.

The effect of different sediment types on the staining effectiveness of the fluorochrome DAPI (4'-6-diamidino-2-phenylindole dihydrochloride) over a wide range of concentrations and on the masking effect of sediment particles on DAPI-stained bacteria was studied. Sediment type greatly affects the staining efficiency of DAPI, and most published studies seem to have underestimated bacterial abundances by using suboptimal concentrations of the fluorochrome. By using a measure of turbidity (A sub 750) to indicate masking and the quartz-corrected water content as a measure of the initial (in situ) dilution of each sediment type, it becomes possible to show a linear relationship between masking and the integrated (initial x experimental) dilution of various sediments. This relationship allows the development of a correction procedure for masking which makes accurate and unbiased counts possible. Data so obtained show a strong relationship between bacteria (cells per milliliter of fresh sediment) and sediment organic matter (grams (dry weight) per milliliter of fresh sediment), one that is not discernible without the correction. The proposed method of staining and correction for sediment masking provides the basis for a standardized interpretation of sediment bacterial counts. (Doria-PTT)
W89-11509

PHYTOPLANKTON POPULATION DENSITY AND VOLUME AS INDICATORS OF EUTROPHICATION IN THE EASTERN PART OF THE ADRIATIC SEA.
Biological Inst., Dubrovnik (Yugoslavia).
For primary bibliographic entry see Field 2L.
W89-11555

PARTITION OF TRACE METALS BETWEEN DISSOLVED AND PARTICULATE PHASES IN EUROPEAN COASTAL WATERS: A COMPILATION OF FIELD DATA AND COMPARISON WITH LABORATORY STUDIES,
Marine Lab., Aberdeen (Scotland).
P. W. Balls.
Netherlands Journal of Sea Research NFSRBA, Vol. 23, No. 1, p 7-14, February 1989. 1 fig, 3 tab, 58 ref.

Descriptors: *Pollutant identification, *Trace metals, *Heavy metals, *Coastal waters, Partition coefficients, Suspended solids, Laboratory analyses, Field data, Isotopic tracers, Water quality.

The recent literature on trace metal distributions in water and suspended particulates has been examined and partition coefficients calculated. However, since most surveys do not determine trace metals in both phases and record the suspended solids loading, these calculations are limited. The results indicate that for most metals the partition coefficient is dependent on solids loading. This finding is in agreement with previous laboratory based experiments. However, partition coefficients from the field are generally greater than those obtained in laboratory experiments. One possible source of difference is that the chemical techniques using strong acid extract metals from the lattice of particulates, whereas tracer techniques used in laboratory experiments generally run for insufficient time to incorporate isotopes into such sites. It was concluded that partition coefficients are essential in the development of water quality models, and they may also be used to assess the magnitude of future changes in total metal concentrations on the dissolved and particulate phases. (White-Reimer-PTT)
W89-11568

ANALYSIS OF ALDEHYDES IN CLOUD--AND FOGWATER SAMPLES BY HPLC WITH A POSTCOLUMN REACTION DETECTOR.
California Inst. of Tech., Pasadena. W.M. Keck Engineering Lab. of Hydraulics and Water Resources.
M. Igawa, J. W. Munger, and M. R. Hoffmann.
Environmental Science and Technology ESTHAG, Vol. 23, No. 5, p 556-561, May 1989. 7 fig, 3 tab, 22 ref.

Descriptors: *Pollutant identification, *Chemistry of precipitation, *Air pollution, *Aldehydes, *Fog, *Clouds, *Chromatography, Chemical analysis, Liquid chromatography, Aliphatic hydrocarbons.

High-performance liquid chromatography (HPCL) coupled with a segmented-flow analyzer was used for the analysis of aldehydes. The aldehydes, which were separated on a reversed-phase C18 column, were derivatized with 3-methyl-2-benzothiazolinone hydrazone (MBTH) and detected at 640 nm. MBTH reacts readily with all aliphatic aldehydes to form MBTH derivatives with high molar absorptivities. Aldehydes below 1 microM can be easily detected by this method. Because aldehydes and other solutes are separated by HPLC before derivatization, free aldehydes are detected without interference. Aldehydes in cloud-water and fogwater samples were analyzed, and formaldehyde, acetaldehyde, glyoxal, and methylglyoxal concentrations were determined. Results obtained with the MBTH method were consistent

with those obtained with the 2,4-dinitrophenylhydrazine (DNPH) method. The MBTH method allows for the rapid determination of the concentration of free aldehydes; the DNPH method will yield similar results, although the procedure is more cumbersome and time consuming. Other advantages of the MBTH method include the generation of only one peak for one dicarbonyl, no losses due to precipitation during analysis, and little interference from other components. (Author's abstract)
W89-11619

CONTAINER ADSORPTION OF TRIBUTYLTIN (TBT) COMPOUNDS: IMPLICATIONS FOR ENVIRONMENTAL ANALYSIS.
Warrnambool Inst. of Advanced Education (Australia). Faculty of Applied Science and Technology.
R. J. Carter, N. J. Turoczy, and A. M. Bond.
Environmental Science and Technology ESTHAG, Vol. 23, No. 5, p 615-617, May 1989. 2 fig, 13 ref.

Descriptors: *Pollutant identification, *Organotins, *Sample preservation, *Sampling, *Pesticides, Tributyltin, Organotin compounds, Chemical analysis, Atomic absorption spectrophotometry, Polycarbonate, Glass, Perspex, Polarographic analysis.

The polarographic response of tributyltin (TBT) as the chloride in 0.1 M NH4NO3 at pH 5.3 was examined in a number of cells constructed from materials commonly used in the collection, storage, and analysis of environmental samples. The response per unit concentration was greatest with polycarbonate and least with Perspex. This change is ascribed to significant adsorption of TBT onto the polarographic cell, electrodes, and stirrer. Graphite furnace atomic absorption spectrometry (GFAAS) was used to confirm the relative response for polycarbonate, glass, and Perspex. Adsorption was shown to take place on glass in less than 1 min after mixing. If polarographic methods are to be used for determination of TBT, then polycarbonate electrodes should be substituted for the usual glass system. The use of Perspex cells, frequently used for the polaragraphic determination of metal ions, is not recommended. (Author's abstract)
W89-11624

EVALUATION OF 'LABILE' METAL IN SEDIMENTS BY USE OF ION-EXCHANGE RESINS.
Newcastle Univ. (Australia). Dept. of Chemistry.
A. Beveridge, P. Waller, and W. F. Pickering.
Talanta TLNTA2, Vol. 36, No.5, p 535-542, May 1989. 6 tab, 14 ref.

Descriptors: *Pollutant identification, *Sediment-water interfaces, *Heavy metals, *Ion exchange, Resins, Hydrogen exchangers, Sodium exchangers, Atomic absorption spectrophotometry.

The metal content of a series of contaminated sediments has been determined by equilibrating ion-exchange resins of different types (held in porous cages) with aqueous suspensions of the sediments. H(+)-form exchangers took up high proportions of the Cu, Pb, Zn, and Cd contents with recoveries depending on whether the acid functional groups were strong. Na(+)-form exchangers took up a smaller, loosely bound, labile fraction. The metal ions held on the exchangers were back-extracted into 0.05 M EDTA and determined by flame atomic-absorption spectrometry. Dissolution of sediment components led to the exchangers also taking up large amounts of Ca, Mg, Fe, and Al. The exchange-resin technique provides an alternative means of subdividing the metal content of sediments into different 'labile' or 'available' fractions. Possible advantages include minimal re-adsorption of released metal ions by the sediment phases, retention of only 'labile' species (ions or complexes), and a transfer mechanism which may resemble the action of plant roots more closely than chemical extractant processes do. (Author's abstract)
W89-11628

NORMAL-PHASE HIGH-PERFORMANCE LIQUID CHROMATOGRAPHIC DETERMINATION OF PHENOLS.
Moscow State Univ. (USSR). Dept. of Chemistry.
S. N. Lanin, and Y. S. Nikitin.
Talanta TLNTA2, Vol. 36, No.5, p 573-579, May 1989. 8 fig, 5 tab, 20 ref.

Descriptors: *Pollutant identification, *Water analysis, *Chemical analysis, *Phenols, *Chromatography, Extraction, Chemical analysis.

Normal-phase high-performance liquid chromatography was used for separation of phenol and its monoderivatives. Multi-component mixtures of hexane (non-polar component) with butan-1-ol, chloroform, butyl bromide, butyl chloride or diethyl ether (polar additives) were used as selective eluents. Silica gel 'Silasorb 600' with specific surface area of about 600 sq m/g and average particle size of approximately 10 microm was used as the sorbent. Phenol and the o-, m-, p-isomers of cresol were concentrated by extraction with n-butyl acetate from aqueous solutions. The data indicate that the elution time, the selectivity and resolution may be controlled by changing the composition of the eluent. In addition, the nature and composition of the eluent can also considerably affect the ultraviolet-detection of the separated phenols. The eluent composition should be selected according to the absorption bands of the eluent and UV sample components, to ensure that the detector wavelengths correspond to the maximum absorbance for the sample components. The results show that the proposed method of extractive preconcentration followed by liquid chromatography analysis is fast and reliable for the determination of phenols and their isomers in aqueous solution. (White-Reimer-PTT)
W89-11629

USE OF CAPILLARY SUPERCRITICAL FLUID CHROMATOGRAPHY AND MICROCOLUMN LIQUID CHROMATOGRAPHY FOR THE DETERMINATION OF NONVOLATILE ORGANICS IN AQUEOUS ENVIRONMENTAL SAMPLES.
Indiana Univ. at Bloomington. Dept. of Chemistry.
C. Borra, F. Andreolini, and M. Novotny.
Analytical Chemistry ANCHAM, Vol. 61, No. 11, p 1208-1210, June 1, 1989. 3 fig, 31 ref.

Descriptors: *Pollutant identification, *Separation techniques, *Organic compounds, *Chromatography, Chemical analysis, Detection limits, Capillary fluid chromatography, Liquid chromatography, Groundwater, Surface water.

A large spectrum of nonvolatile trace organics from various water samples was preconcentrated for the subsequent high-resolution analysis. The separations involve microcolumn liquid chromatography (LC) with ultra-violet (UV) detection at 230 nm and capillary supercritical fluid chromatography with flame ionization detection. Water samples from different sources showed different degrees of complexity. Recoveries at part-per-billion levels, between 60% and 90%, were obtained for model solutes. The major advantages of using capillary LC with slurry-packed columns for the analysis of nonvolatile and thermally labile organic compounds present in groundwater and surface water samples include: (1) very high separation efficiency; (2) the possibility of monitoring compounds with a broad range of polarity using gradient elution; and (3) the minimum detectable quantity below 10 to the minus 9th power g, allowing the detection of substances in water samples at parts-per-trillion levels. However, resolution of very complex mixtures may necessitate long analysis times. Although detection at wave lengths of 230 nm or lower facilitates monitoring numerous organics, the lack of a universal detector in LC remains a major drawback of this technique. (White-Reimer-PTT)
W89-11634

DETERMINATION OF TOTAL MERCURY IN WATER AND URINE BY A GOLD FILM SENSOR FOLLOWING FENTON'S REAGENT DIGESTION.
Texas Tech Univ., Lubbock. Dept. of Chemistry and Biochemistry.
L. Ping, and P. K. Dasgupta.
Analytical Chemistry ANCHAM, Vol. 61, No. 11, p 1230-1235, June 1, 1989. 5 fig, 2 tab, 38 ref.

Descriptors: *Pollutant identification, *Mercury, *Chemical analysis, Detection limits, Fenton's reagent, Gold film sensor, Digestion, Sodium chloride.

Fenton's reagent (Fe(II) + H2O2) was utilized for the digestion of environmental water samples and urine. Following the digestion, which converts organic forms of Hg to inorganic Hg(II), Hg(0) is liberated by borohydride reduction and measured by a conductometric gold film sensor. Quantitative recovery of Hg from samples spiked with mercuric chloride, methylmercury (II)chloride, and phenylmercury (II) acetate was attainable in the presence of naturally occurring suspended matter and humic and fulvic acids as well as 3% NaCl. The digestion is performed at moderate pH (3-4) and temperature (< or = 50 C) and does not use large amounts of any reagent. Excellent agreement is shown for reference water, wastewater, and urine standards. The limit of detection, facilitated by the low blank value, is 500 pg of Hg or 10 ng/L for a 50 mL sample. The method tolerates large amounts of NaCl and it is potentially applicable to seawater; however, the final determination method used in this work is not sufficiently sensitive to reliably measure low or sub-nanogram-per-liter levels with a reasonable sample volume. (Author's abstract)
W89-11635

DETERMINATION OF LEAD IN WATERS AND SEDIMENTS OF LAKE DONNER, CALIFORNIA.
California State Polytechnic Univ., Pomona. Dept. of Chemistry.
R. J. Michels, and J. Sneddon.
Journal of Environmental Science and Health (A) JESEDU, Vol. 24A, No. 2, p 127-133, February 1989. 1 fig, 1 tab, 4 ref.

Descriptors: *Pollutant identification, *Lake sediments, *Lead, *Atomic absorption spectrophotometry, *Lakes, *California, Chemical analysis, Measuring instruments, Detection limits, Precision.

A method for the determination of lead in waters and sediments by electrothermal atomization atomic absorption spectrometry was developed and applied to Lake Donner in California. A Perkin-Elmer Model 4000 microprocessor controlled atomic absorption spectrometer, and a Perkin-Elmer hollow cathode lamp operating at 10 mA and a wavelength of 283.3 nm were used. Water samples were collected from six locations at depths of 0.5 and 14.5 feet. Sediment samples were obtained using a spring loaded 'grab' sampler at a distance approximately 50 yards from shore. The preliminary results show that most of the lead is found in the lake sediments. Lead concentrations on the surface waters were < 2.0 microg/L and at a depth of 14.5 feet had increased to around 40 microg/L. This finding implies that any lead deposited on the surface will move to the bottom of the lake and become concentrated. The electrothermal atomization atomic absorption spectrometric method for determining the lead in the waters and sediments gave a low detection, good precision, and acceptable accuracy. (White-Reimer-PTT)
W89-11643

ORGANO-TINS IN SEDIMENTS AND MUSSELS FROM THE SADO ESTUARINE SYSTEM (PORTUGAL).
Bordeaux-1 Univ., Talence (France). Groupe d'Oceanographie Physicochimique.
For primary bibliographic entry see Field 5B.
W89-11650

ESTABLISHING AND MAINTAINING LABORATORY-BASED MICROCOSMS OF RIFFLE INSECT COMMUNITIES: THEIR POTENTIAL FOR MULTISPECIES TOXICITY TESTS.
Virginia Polytechnic Inst. and State Univ., Blacks-

burg. Center for Environmental and Hazardous Material Studies.
K. W. Pontasch, and J. Cairns.
Hydrobiologia HYDRB8, Vol. 175, No. 1, p 49-60, April 29 1989. 3 fig, 2 tab, 32 ref.

Descriptors: *Culturing techniques, *Riffles, *Bioindicators, *Aquatic insects, *Bioassay, *Artificial watercourses, *Stream biota, *Toxicity, Substrates, Simulation, Mayflies, Ecosystems, Midges, Population density, Comparison studies.

The most logistically simple, yet effective artificial stream design for maintaining riffle insects during a 30 d bioassay was determined from among (1) static and no current (S-NC), (2) flow-through and no current (FT-NC), (3) static with current (S-C), and (4) flow-through with current (FT-C). Flow-through and current, when provided, were 12 ml/min and 30 cm/sec, respectively. Streams were covered by emergence traps, and daylight equivalent lights provided a natural photoperiod. The four stream designs were evaluated in triplicate based on changes in insect species abundances after 30 d. Test organisms were transferred to the artificial streams in rock-filled containers previously colonized for 30 d in a third-order mountain stream riffle. Additional colonized substrates were sampled immediately to provide an estimate of initial densities placed in the artificial streams. Hess samples were taken directly from the source riffle to evaluate how well the artificial substrates reflected species-abundances on the natural substrate. Adults were collected from the artificial streams every 48-72 h to determine the percentage of initial densities that emerged. After 30 d, all organisms remaining in the streams were censused. Designs were evaluated using combined densities of adults and young. Results of the study showed that the FT-C and S-C stream designs maintained most taxa at or above initial densities, and even in the FT-NC and S-NC streams, densities of some taxa were not significantly different ($P < or = 0.05$) from initial densities. Emergent adults comprised a large proportion of mayfly and chironomid densities and must be monitored during bioassays with aquatic insects. These results indicate that microcosms of riffle insect communities can be maintained for at least 30 d with moderate current and minimal flow-through. (Author's abstract)
W89-11656

SUCCESSFUL PRESERVATION OF DAPHNIA FOR CHEMICAL AND PHYSICAL ANALYSIS.
Minnesota Univ., Minneapolis. Limnological Research Center.
J. Shapiro, and D. Wright.
Hydrobiologia HYDRB8, Vol. 175, No. 1, p 61-63, April 29 1989. 1 tab, 3 ref.

Descriptors: *Sample preservation, *Tissue analysis, *Daphnia, *Crustaceans, *Pollutant identification, Chemical analysis, Bioaccumulation, Phosphorus, Carbon, Water pollution effects, Aquatic animals, Toxicity.

A method for preserving Daphnia for subsequent phosphorus and carbon analyses is presented. The technique overcomes the problems of contact of dead animals with water, which results in variable losses of weight and phosphorus. The procedure involves the filtering of live D. pulicaria onto course screens and quickly freezing them in dry ice in the absence of excess water. The screens may then be put into a prechilled Petri dish, which is then wrapped in polyethylene or Saran and stored frozen. Length of individual organisms is unaffected by the process and eggs and young may be counted accurately. (Friedmann-PTT)
W89-11657

EVALUATION OF DIFFERENT PLATING MEDIA USED IN THE ISOLATION OF SALMONELLAS FROM ENVIRONMENTAL SAMPLES.
Malaga Univ. (Spain). Dept. of Microbiology.
M. A. Morinigo, E. Martinez-Manzanares, A. Munoz, R. Cornax, and P. Romero.
Journal of Applied Bacteriology JABAA4, Vol. 66, No. 4, p 353-360, April 1989.

Descriptors: *Culture media, *Salmonella, *Pollutant identification, *Bacterial analysis, *Culturing techniques, *Growth media, Bacteria, Sampling, Performance evaluation, Comparison studies.

Different serotypes of salmonellas were compared for selectivity and efficiency of recovery using 11 plating media. No optimal growth was obtained after 24 h incubation in any of the media, but after 48 h, brilliant green, brilliant green-phenol red-lactose-sucrose, bismuth sulfite, xylose-lysine-deoxycholate and Hektoen enteric agars showed optimal recovery of all the salmonella serotypes. Xylose-lysine-deoxycholate and brilliant green-phenol red-lactose-sucrose agars were the most selective media for all salmonella serotypes. Addition of 10 micrograms/ml of sodium novobiocin to the tryptic soy-xylose-lysine and tryptic soy-brilliant green agars significantly improved their selectivity but reduced or inhibited the growth of some salmonella serotypes, including Salmonella typhi. Xylose-lysine-deoxycholate agar gave the highest recovery percentage of stressed salmonellas with a double-agar layer technique. Good recovery was also obtained on brilliant green-phenol red-lactose-sucrose, tryptic soy-brilliant green, tryptic soy-brilliant green-novobiocin, tryptic, soy-xylose-lysine and tryptic soy-xylose-lysine-novobiocin agars. Salmonella-shigella agar was the least efficient medium for the recovery of salmonellas under stress-induced or non-stressed conditions. (Author's abstract)
W89-11671

DETERMINATION OF CARBONYL COMPOUNDS IN OZONATED WATER BY THE PFBOA METHOD,
Kyoto Univ. (Japan). Faculty of Engineering.
H. Yamada, and I. Somiya.
Ozone: Science and Engineering OZSEDS, Vol. 11, No. 2, p 127-141, 1989. 8 fig, 4 tab, 15 ref.

Descriptors: *Water treatment, *Disinfection, *Pollutant identification, *Ozone, *Ozonation, Organic compounds, Gas chromatography, Formaldehyde, Chemical reactions, Chemical properties, Wastewater analysis, Mass spectrometry.

Many researchers have found aromatic, phenolic, aliphatic mono--and di-carboxylic acids, aldehydes, and ketones to be present in ozonated drinking water. However, not all of the intermediates and end products formed during ozonation are known. This is due to the fact that ozone reactions are very complex because ozone itself is unstable; the concentration of the by-product may be too small for analysis; the number of products may by very large, and many by-products are polar. For example, low molecular weight aldehydes and ketones are very polar substances which usually are not identified by analytical methods that involve typical preconcentration steps. PFBOA, O-(2,3,4,5,6-pentafluorobenzyl)hydroxylamine, is excellent as a derivatizing agent in the gas-chromatographic determination of carbonyl compounds in ozonated water samples in surface and wastewaters. The carbonyl ozonation by-products were identified as PFBOA derivatives by gas chromatography-mass spectrometry. The by-products of ozonation identified were formaldehyde, glyoxal, methylglyoxal, and 13 other compounds. The production characteristics of the main by-products during ozonation were: maximum concentrations of formaldehyde, 2 micrograms/L after 20 min of ozonation, glyoxal, 1 microgram/L after 3 min., and methylglyoxal, 1.7 micrograms/: after 10 min, all at pH 6.6. No formaldehyde was observed after 40 minutes. (Friedmann-PTT)
W89-11692

TOXICITY TEST OF LANDFILL LEACHATE USING SAROTHERODON MOSSAMBICUS (FRESHWATER FISH).
Hong Kong Baptist Coll., Kowloon. Dept. of Biology.
For primary bibliographic entry see Field 5C.
W89-11728

INHIBITION OF ACETYLCHOLINESTERASE IN GUPPIES (POECILIA RETICULATA) BY CHLORPYRIFOS AT SUBLETHAL CONCENTRATIONS: METHODOLOGICAL ASPECTS.
Institute for Pesticide Research, Wageningen (Netherlands).
H. van der Wel, and W. Welling.
Ecotoxicology and Environmental Safety EESADV, Vol. 17, No. 2, p 205-215, April 1989. 5 fig, 3 tab, 21 ref.

Descriptors: *Organophosphorus pesticides, *Sublethal effects, *Bioindicators, *Water pollution effects, *Enzymes, *Pesticides, *Pollutant identification, *Guppies, Fish physiology, Chlorpyrifos, Toxicity, Acetylcholinesterase, Solvents, Oxygen, Recovery, Inhibition.

Acetylcholinesterase activity is a potential biochemical indicator of toxic stress in fish and a sensitive parameter for testing water for the presence of organophosphates. A number of methodological aspects regarding the determination of the in vivo effect of chlorpyrifos on acetylcholinesterase in guppies have been investigated. It was found that with acetylthiocholine as a substrate, the contribution of pseudocholinesterase to the total cholinesterase activity can be neglected. Protection of acetylcholinesterase of guppies exposed to chlorpyrifos from additional, artifactual in vitro enzyme inhibition during homogenization is necessary. Very low concentrations of acetone in the exposure medium, resulting from dilution of the stock solution of chlorpyrifos in acetone, can result in large decreases in the oxygen content of this medium. This may affect the uptake rate of the toxic compound and, thereby, cholinesterase inhibition. Very low, sublethal concentrations of chlorpyrifos result in high inhibition levels of acetylcholinesterase (80-90%) in guppies within 2 weeks of continuous exposure. Recovery of the enzyme activity occurs after the exposed animals are kept in clean medium for 4 days, but the rate of recovery is considerably lower than the rate of inhibition. (Author's abstract)
W89-11733

PRESERVATION OF SAMPLES FOR DISSOLVED MERCURY.
Geological Survey, Sacramento, CA. Water Resources Div.
S. N. Hamlin.
Water Resources Bulletin WARBAQ, Vol. 25, No. 2, p 255-262, April 1989. 1 tab, 39 ref.

Descriptors: *Water analysis, *Pollutant identification, *Sample preservation, *Mercury, *Chemical analysis, Nitric acid, Potassium dichromate, Air pollution, Sample preparation, Sampling, Laboratory methods.

Water samples for dissolved mercury require special treatment because of the high chemical mobility and volatility of this element. Widespread use of mercury and its compounds has provided many avenues for contamination of water. Two laboratory tests were done to determine the relative permeabilities of glass and plastic sample bottles to mercury vapor. Plastic containers were confirmed to be quite permeable to airborne mercury, glass containers were virtually impermeable. Methods of preservation include the use of various combinations of acids, oxidants, and complexing agents. The combination of nitric acid and potassium dichromate successfully preserved mercury in a large variety of concentrations and dissolved forms. Because this acid-oxidant preservative acts as a sink for airborne mercury and plastic containers are permeable to mercury vapor, glass bottles are preferred for sample collection. To maintain a healthy work environment and to minimize potential for contamination of water samples, mercury and its compounds are isolated from the atmosphere while in storage. Concurrently, a program to monitor environmental levels of mercury vapor in areas of potential contamination is needed to define the extent of mercury contamination and to assess the effectiveness of mercury clean-up procedures. (Author's abstract)
W89-11786

NEW APPROACH TO THE SEVEN-DAY CERIODAPHNIA DUBIA TEST WITH ADDITIONAL COMMENTS PERTAINING TO THE SAME TEST FOR DAPHNIA MAGNA.
Dow Chemical U.S.A., Midland, MI. Health and Environmental Sciences.
U. M. Cowgill, and D. P. Milazzo.
Bulletin of Environmental Contamination and Toxicology BECTA6, Vol. 42, No. 5, p 749-753, March 1989. 2 tab, 9 ref.

Descriptors: *Pollutant identification, *Bioassay, *Waterfleas, *Daphnia, *Bioindicators, *Water pollution effects, *Toxicity, Effluents, Diets, Ceriodaphnia, Wastewater analysis, Algae, Lipids.

The redesigned seven-day Ceriodaphnia test is described. The aquatic toxicology test was originally designed as an efficient and easy method for estimating toxicity of effluents. The redesigned test has the inherent requirements of the test animals in mind and has increased the efficiency and the success rate. The major changes that have been installed have in no way changed the basic tenets if the original test but have emphasized the fundamental needs of the animals in terms of space and diet. The diet has been changed from the trout chow + yeast + cerophyll to a mixed algal diet, the latter being closer to what C. dubia consumes in nature. C, dubia maintained on a mixed diet has an adequate supply if lipids as neonates are able to survive axenically in the absence of algal or any other source of food for 10 days. The synthetic diets do not supply the animals with a sufficient lipid supply to sustain them in the absence of food for the length of the 48 h static acute test. The second major change that has been instituted is that of an increased test solution volume which allows the organism more living space. The third change, and probably the most important one, is that of reduced handling of the test neonate. It was found that the increase in space for C. dubia coupled with the reduced handling, and a mixed algal diet has permitted the execution of this seven-day test efficiently and easily in compliance with the test requirements. (Miller-PTT)
W89-11811

INFLUENCE OF DISSOLVED ORGANIC CARBON ON PH MEASUREMENTS OF LOW SOLUTE CONTENT WATERS,
Lockheed Engineering and Sciences Co., Inc., Las Vegas, NV. Environmental Programs Office.
R. C. Metcalf, D. V. Peck, and L. J. Arent.
Geochimica et Cosmochimica Acta GCACAK, Vol. 53, No. 4, p 773-784, April 1989. 3 fig, 7 tab, 81 ref. EPA contract 68-03-3249.

Descriptors: *Acidity, *Acid rain data, *Organic carbon, *Hydrogen ion concentration, *Solutes, Lakes, Streams, Electrodes, Laboratory methods, Surface water.

The concern that dissolved organic carbon (DOC) interferes with pH electrode measurements of low solute content waters was examined. Using Ross pH combination electrodes according to protocols of the U.S. Environmental Protection Agency's National Surface Water Survey (NSWS), laboratory pH measurements of 0.0001 N H2SO4 standards (spiked from 0 to 100 mg/L DOC with potassium hydrogen ortho-phthalate, humic acid, or the surfactant Tergitol 15-S-9) showed little or no evidence of DOC interference, within the +or-0.05 pH unit measurement precision. Concern with DOC-induced pH measurement errors prompted previous researchers to advocate using a calculated pH value, based on measurements of dissolved inorganic carbon (DIC), PCO2, water temperature and the appropriate carbonate equilibria. CO2-equilibrated pH measurements from the Eastern Lake Survey Phase-I showed no significant difference with calculated pH values based on the above model. A limited sensitivity analysis of the errors associated with direct pH electrode measurements compared to calculated pH values indicates that, for a regional survey taking place over weeks or months, potentiometric determinations are more precise at present. All of this evidence suggests that the pH measurements for the NSWS (as well as a long series of prior regional studies) are unaffected by DOC-induced pH measurement errors, although reference electrode junction errors still deserve greater attention in many studies. (Author's abstract)
W89-11822

ANALYSIS OF TRACE ORGANICS IN THE AQUATIC ENVIRONMENT.
CRC Press, Inc., Boca Raton, Florida. 1989. 346 p. Edited by B. K. Afghan and Alfred S. Y. Chau.

Descriptors: *Trace levels, *Water analysis, *Pollutant identification, *Organic compounds, *Chemical analysis, *Aquatic environment, Water quality control, Toxaphene, Humic acids, Polychlorinated biphenyls, Phenols, Dioxins, Volatile organic compounds, Chlorinated hydrocarbons, Environmental quality, Organometallic compounds, Sampling, Sample preparation, Cleanup.

The importance of environment assessment pollution control to protect and upgrade environmental quality, has led to the necessity and demand in the study and monitoring of the pollutants in the aquatic environment. One of the key elements of effective quality assurance to ensure reliable data generation is the availability of reliable analytical methods and their appropriate application. This book is part of a multi-volume work which is designed to provide, in a single source, theories, analytical techniques, and methodologies necessary for understanding and determining the trace organic contaminants in various compartments of the aquatic environment. The first three volumes dealt with the analysis of pesticide residues and their toxic degradation products in the aquatic environment. This final volume covers the toxaphene, organometallic compounds, humic acids, and related substances and industrial chemicals such as PCBs, phenols, chlorinated dioxins, and volatile organics. Each chapter covers practical applications of techniques, and provides state-of-the art methodologies in current use with special reference to sampling, concentration, cleanup, quantitative and confirmatory analysis. (See W89-11868 thru W89-11877) (Lantz-PTT)
W89-11868

ANALYSIS OF VOLATILE HALOGENATED AND PURGEABLE ORGANICS.
National Water Research Inst., Burlington (Ontario).
B. G. Oliver.
IN: Analysis of Trace Organics in the Aquatic Environment. CRC Press, Inc., Boca Raton, Florida. 1989. p 1-29, 3 fig, 4 tab, 185 ref.

Descriptors: *Water analysis, *Pollutant identification, *Volatile organic compounds, *Organic compounds, *Chemical analysis, Conductivity, Separation techniques, Drinking water, Trihalomethanes, Chloroform, Fulvic acids, Bromodichloromethane, Groundwater quality, Chlorodibromomethane, Chlorination, Disinfection, Halogenated hydrocarbons, Measuring instruments.

Interest in the presence of volatile halogenated compounds in water has been high for several years because of the discovery of the ubiquitous presence of trihalomethanes, THMs, in chlorinated drinking water in several countries. The THMs, chloroform, bromodichloromethane, chlorodibromomethane, and bromoform, are formed from the reaction of chlorine with naturally occurring organics such as fulvic acid, algae, etc., during water disinfection. There is also concern about other volatile halogenated compounds that are not water chlorination byproducts such as tetrachloroethylene and carbon tetrachloride because they have been found at high concentrations in some drinking waters from groundwater sources. In general the compounds have low boiling points (< 200 C), high vapor pressures (> or = 1 torr), low water solubilities, and fairly low octanol/water partition coefficients. Massive quantities of these materials are produced in the U.S. which is only a fraction (1/2 to 1/5) of world production. The authors recommend the liquid-liquid extraction/electron capture detector (LLE/ECD) method for routine monitoring of drinking water for THMs and for several other halogenated solvents such as trichloro--and tetrachloroethylene because the method exhibits good sensitivity for these compounds, both the extraction and chromatographic procedures are simple, and the method is easily automated. For general volatile organics scanning of drinking water, wastewater, and ambient waters the purge and trap/electrolytic conductivity detector (P and T/ELCD) method is recommended. This method provides good sensitivity for a broader range of compounds, is reasonably simple and can be partially automated. Detailed methods for sediments and biota are not presented because the methods are still in the developmental stage, and because the need for such methods (because of the low tendency of the compounds to partition into these phases) has yet to be demonstrated. (See also W89-11868) (Lantz-PTT)
W89-11869

POLYCHLORINATED BIPHENYLS.
National Water Research Inst., Burlington (Ontario).
B. G. Oliver, R. M. Baxter, and H.-B. Lee.
IN: Analysis of Trace Organics in the Aquatic Environment. CRC Press, Inc., Boca Raton, Florida. 1989. p 31-68, 10 fig, 3 tab, 252 ref.

Descriptors: *Water analysis, *Pollutant identification, *Polychlorinated biphenyls, *Chemical analysis, *Aroclors, Waste disposal, Fate of pollutants, Chemical properties, Water sampling, Sediments, Animal tissues, Sample preparation, Separation techniques, Adsorption, Distillation, Gas chromatography, Electron capture gas chromatography, Mass spectrometry.

Polychlorinated biphenyls (PCBs) are, or have been, manufactured in several countries; in the U.S., they were produced under the trade name 'Aroclor'. Recognition of the undesirability of PCBs has lead to considerable research on methods for destroying them. PCBs can be destroyed by burning in incinerators, diesel engines, lime kilns, and high efficiency boilers. Care is required because at insufficiently high temperatures the pyrolysis of PCBs may lead to the formation of polychlorinated dibenzo-p-dioxins (PCDDs) and polychlorinated dibenzofurans (PCDFs), some of which are much more toxic than PCBs, and to losses of some PCBs to the atmosphere. Low level wastes, such as transformer oils contaminated with relatively small amounts of PCBs may be dealt with by one of several processes involving the reaction of the chlorobiphenyls with sodium to produce sodium chloride and an inert polymer. When analyzing for PCBs, water samples are generally collected in glass, Teflon, or stainless-steel containers. Wet sediment samples, in clean solvent-rinsed jars, should be frozen until analysis. Fish and other biota to be tested for PCBs are usually wrapped in solvent-cleaned aluminum foil or placed in glass jars and likewise frozen until analysis. All water used in the PCB procedures must be free from organic interferences. Procedures for isolation of PCBs from water fall into three categories: (1) liquid/liquid extraction with organic solvents, (2) adsorption using columns packed with various adsorbents, and (3) steam distillation. Soxhlet extraction is usually considered the most exhaustive procedure for extraction of chlorinated contaminants from sediments. Biota and fish samples are first homogenized in a blender, the mixture is then dried by either grinding or blending with anhydrous sodium sulfate until free-flowing before soxhlet, column, or batch extraction. The quantification of PCBs is normally carried out using either packed-column or capillary-column gas chromatography with a halogen-sensitive detector, such as the electron-capture detector, or a mass spectrometer in the electron-impact or chemical-ionization mode. (See also W89-11868) (Lantz-PTT)
W89-11870

ANALYSIS OF TOXAPHENE IN ENVIRONMENTAL SAMPLES.
Department of Fisheries and Oceans, Burlington (Ontario). Great Lakes Lab. for Fisheries and Aquatic Sciences.
D. B. Sergeant, and F. I. Onuska.
IN: Analysis of Trace Organics in the Aquatic Environment. CRC Press, Inc., Boca Raton, Flori-

da. 1989. p 69-118, 16 fig, 11 tab, 203 ref.

Descriptors: *Water analysis, *Chemical analysis, *Pollutant identification, *Insecticides, *Toxaphenes, Fate of pollutants, Path of pollutants, Organic compounds, DDT, Sediments, Biological samples, Fish, Sampling, Sample preservation, Chemical analysis, Separation techniques, Gas chromatography, Electron capture gas chromatography, Spectrophotometry, Detection limits, Quality control.

When DDT use was banned in December 1972 because of its adverse environmental effects, toxaphene use increased dramatically to fill the void in pest-control programs. In turn, toxaphene itself was discovered to be an environmental problem. Today, most uses of toxaphene are banned in Canada, the U.S., and in many other countries. However, the legacy of its pesticide use remains as it continues to recycle between various compartments in the environment. The Canada/U.S. International Joint Commission, which monitors environmental quality in the Great Lakes basin, recommends that 'The concentration of toxaphene in water should not exceed 0.008 microg/L for the protection of aquatic life'. Toxaphene sediment degradation products remain toxic to fish after 10 months in the environment. Given the major use of toxaphene as an insecticide on crops, it is not unexpected to find toxaphene incorporated into the surrounding soil and in the sediments of adjacent rivers and lakes because of runoff. Rivers and lakes are probably the ultimate sinks for this compound and its degradation products. Two relatively accessible Environmental Protection Agency toxaphene methods are available in the U.S. Federal Register. Both methods provide extensive detail on scope of method; quality control; sample collection, preservation, and handling; sample extraction and cleanup; and gas chromatographic analysis by packed columns. A second set of reliable and universally-accepted methods for toxaphene are the general organochlorine and organophosphate methods described in the Association of Official Analytical Chemists Official Methods of Analysis. Quantitation is by thin-layer and gas chromatography. The U.S. Department of the Interior Fish Toxaphene Method permits the analyst to quantitate toxaphene residues in fish down to 0.1 microg/g. Samples are analyzed by both standard packed-column gas chromatography and gas chromatography with electron-capture detection. A toxaphene method from the Canada Department of Fisheries and Oceans Ultratrace Laboratory is suitable for the analysis of water, sediments, biota, and fish. Detection limits of 0.05 microg/g for fish and <15 microg/L for water are achieved. (See also W89-11868) (Lantz-PTT)
W89-11871

ENVIRONMENTAL ASPECTS AND ANALYSIS OF PHENOLS IN THE AQUATIC ENVIRONMENT.
National Water Research Inst., Burlington (Ontario).
J. M. Carron, and B. K. Afghan.
IN: Analysis of Trace Organics in the Aquatic Environment. CRC Press, Inc., Boca Raton, Florida. 1989. p 119-149, 7 fig, 7 tab, 54 ref.

Descriptors: *Water analysis, *Phenols, *Pollutant identification, *Chemical analysis, Pentachlorophenol, Organic compounds, Fate of pollutants, Chlorinated phenols, Automation, Colorimetry, Chromatography, Sample preparation, Aquatic environment, Environmental effects.

Phenols occur in the aquatic environment due to their wide spread usage. Yearly consumption of phenol has been estimated to be in several hundred million kilograms. The monitoring of industrial effluents and natural waters for trace concentration of phenols is also carried out because these compounds can adversely affect the potability of water at low concentration. Chlorinated phenols are also determined in air, water, sediment, and biota to assess their environmental impact on the aquatic ecosystem. For monitoring programs requiring data of submicrogram/L levels of phenol in water, automated methodology, is recommended as a low cost method of analysis. For specific phenols, a very simple colorimetric method could be used that would have low equipment costs and would be very applicable for field use. Technical surveys or research studies may require specific or target phenolic compounds at trace levels requiring specific methods that are more comprehensive. To meet specific or specialized requirements, the methods should employ appropriate preservation, concentration, clean up, and analytical instrumentation that will provide chromatographic analysis at trace levels. The most comprehensive method to date for phenols in water is the EPA document entitled 'Master Analytical Scheme for the Analysis of Organic Compounds in Water'. (See also W89-11868) (Lantz-PTT)
W89-11872

ANALYSIS OF CHLORINATED DIBENZO-P-DIOXINS AND DIBENZOFURANS IN THE AQUATIC ENVIRONMENT.
Ontario Ministry of the Environment, Rexdale. Lab. Services Branch.
R. E. Clement, and H. M. Tosine.
IN: Analysis of Trace Organics in the Aquatic Environment. CRC Press, Inc., Boca Raton, Florida. 1989. p 151-204, 4 fig, 5 tab, 432 ref.

Descriptors: *Water analysis, *Chemical analysis, *Pollutant identification, *Chlorinated hydrocarbons, *Dioxins, *Aromatic compounds, Water pollution sources, Aquatic environment, Sediments, Leachates, Aquatic life, Environmental quality, Air pollution, Toxicity, Bioassay, Sampling, Extraction, Chromatography, Gas chromatography, Mass spectrometry, Detection limits.

Considering their hydrophobic nature, it is perhaps surprising that the chlorinated dibenzo-p-dioxins (CDD) and chlorinated dibenzofurans (CDF) are of considerable importance to the aquatic environment. Concern with the CDD/CDF groups of chemicals even at such low concentrations is a result of considerable research into the toxicity of 2,3,7,8-tetrachlorodibenzo-p-dioxin (2,3,7,8-4CDD). Because of the low detection limits generally required for the analysis of environmental samples for CDDs and CDFs, optimization of the entire analytical process is usually needed. This includes procedures for sampling, extraction, concentration, removal of coextractives, and detection by a sensitive and selective technique. Gas chromatography/mass spectrometry (GC/MS) is universally accepted as the instrumental technique required for the analysis of CDDs and CDFs in environmental samples. A multitude of GC/MS techniques are available. Generally, the choice of GC column for either total congener groups or isomer-specific analysis is the most important GC/MS variable. There has been considerable interest in development of bioanalytical procedures for rapid screening determination of the toxic CDD/CDF congeners. These methods are of interest for large-scale surveys or emergency-response situations where many samples must be tested rapidly to delineate the areas of greatest contamination. In spite of the promise of rapid and inexpensive screening analysis, application of bioanalytical techniques for CDD/CDFs in the environment has not attained wide use. More work is needed to further improve sensitivity, correlate biological response with toxic CDD/CDF congener concentrations and apply these methods to real environmental problems. (See also W89-11868) (Lantz-PTT)
W89-11873

ANALYSIS OF POLYCYCLIC AROMATIC HYDROCARBONS IN ENVIRONMENTAL SAMPLES.
National Water Research Inst., Burlington (Ontario). Research and Applications Branch.
F. I. Onuska.
IN: Analysis of Trace Organics in the Aquatic Environment. CRC Press, Inc., Boca Raton, Florida. 1989. p 205-241, 12 tab, 118 ref.

Descriptors: *Water analysis, *Polycyclic aromatic hydrocarbons, *Pollutant identification, *Chemical analysis, Mass spectrometry, Gas chromatography, Chromatography, Separation techniques, Water pollution sources, Sample preparation, Adsorbents, Risk assessment, Oil pollution, Trace levels, Fluorescence, Particle size, Quantitative analysis, Detection limits.

Polycyclic aromatic hydrocarbons (PAH) represent a class of man-made environmental pollutants to which man has almost constantly been exposed. The source of polynuclear hydrocarbon minerals appears to be the same as that of the man-made pollutants, they are formed by pyrolysis of organic materials at moderate temperatures. Thin-layer chromatography (TLC) has been used for separation of PAHs but has proven useful for quantitative analysis of PAHs in recent years. Column chromatography is the most widely used separation technique for polycyclic aromatic hydrocarbons. A large variety of adsorbents such as alumina, silica gel, cellulose acetate, Floridine, and synthetic gels have been used for separation. Adsorbents with uniform particle size, e.g., 80-100, 100-120, or +200 mesh and column diameter-to-length ratio of 1.2 to 1.5 are suggested. The use of mass spectrometry (MS) and high resolution gas chromatography/mass spectrometry (HRGC/MS) to identify and quantify PAHs in environmental samples is escalating. Water and sediment samples contaminated with petroleum products continue to receive most of the attention. However, the major components of bunker oil dissolved in seawater were found to be acetophenone, phenol, cresols, and 2-phenyl-2-propanol besides naphthalene and its methyl homologues. Studies have identified benzene and naphthalene-related compounds, indanes, biphenyls, and higher PAHs using methylene chloride extraction of estuarine waters contaminated with No.2 fuel oil. Photoluminescence analysis has become well established as a selective and sensitive method for PAH analysis and it has been found to be as sensitive and much cheaper than a mass spectrometric technique. Since photoluminescence spectrometry is a nondestructive analytical method, individual fractions can be collected and subjected to further analysis. The selectivity of fluorescence analysis for PAHs has been refined by characterizing PAH-isomer at two wavelengths. (See also W89-11868) (Lantz-PTT)
W89-11874

PHTHALATE ESTERS IN THE AQUATIC ENVIRONMENT.
National Water Research Inst., Burlington (Ontario).
J. Kohlil, J. F. Ryan, and B. K. Afghan.
IN: Analysis of Trace Organics in the Aquatic Environment. CRC Press, Inc., Boca Raton, Florida. 1989. p 243-281, 2 fig, 8 tab, 141 ref, append.

Descriptors: *Water analysis, *Chemical analysis, *Pollutant identification, *Chlorinated hydrocarbons, *Phthalates, *Water pollution sources, Aquatic environment, Toxicity, Aquatic animals, Water pollution effects, Chemical wastes, Waste disposal, Chemical analysis, Sediments, Fish, Separation techniques, Extraction, Gas chromatography, Electron capture gas chromatography.

Phthalate esters or phthalic acid esters (PAEs) are terms used interchangeably to describe the esters of ortho-phthalic acid. Although PAEs are found in the atmosphere and in land biosphere compartments, this chapter is largely limited to aquatic media. There are two major categories of releases of PAEs to the environment: (1) release from production and processing activities--including losses during PAE production, plasticizer and resin compounding, fabrication of polyvinyl chloride into products, and during production of adhesives, plastisols, coatings, etc.; and (2) release from use and disposal of materials incorporating PAEs--including plasticizer losses during the useful lifetimes of the products or during incineration or landfill. Although the acute toxicity of PAEs to mammals is low, there is evidence that aquatic organisms concentrate PAEs and are more vulnerable to PAEs than warmblooded animals. Disturbances of the reproduction and growth of aquatic species have been demonstrated in water containing low parts-per-billion levels of PAEs. In the recommended method for analysis of PAEs and organochlorines, natural water samples are extracted with dichloromethane, either on-site or in the laboratory. The dichloromethane is evaporated under

reduced pressure and the extract is reconstituted in a small volume of iso-octane. The resultant iso-octane solution is subjected to silica-column clean-up and the appropriate fraction containing the PAEs is analyzed by gas chromatography using a non-polar capillary column with splitless injection, temperature programming and electron-capture detection. Sediment and fish samples can be extracted using soxhlet extraction and/or Polytron homogenization. The resultant extracts are reconstituted into 5 ml of iso-octane. A precleanup column employing micro-Styragel or Bio-Beads SX3 is used to remove large-molecular-weight coextractants and lipids, respectively. The sulfur-containing coextractants are removed by using mercury. The extract is then carried through the same procedure as described for the water matrix to determine PAEs. (See also W89-11868) (Lantz-PTT)
W89-11875

ORGANOMETALLIC COMPOUNDS IN THE AQUATIC ENVIRONMENT.
National Water Research Inst., Burlington (Ontario). Quality Assurance and Methods Section.
Y. K. Chau, and P. T. S. Wong.
IN: Analysis of Trace Organics in the Aquatic Environment. CRC Press, Inc., Boca Raton, Florida. 1989. p 283-312, 7 fig, 1 tab, 142 ref.

Descriptors: *Water analysis, *Pollutant identification, *Organometallic compounds, *Chemical analysis, Separation techniques, Spectrometry, Chromatography, High performance liquid chromatography, Gas chromatography, Aquatic environment, Fluorescence, Spectral analysis, Measuring instruments, Plasma emission spectrometry, Electrochemistry.

Organometallic compounds designate a class of compounds formed from the direct union of metal and carbon of the organic group. Carbonates of metals, complexes of metals with organic ligands or metal salts or organic acids are not classified as organometals. The discussion in this chapter also includes organometalloids such as organoarsenic and organoselenium compounds. The combination system consisting of a separation technique and an element-specific detector is currently the best analytical system for the species analysis of organometallic compounds. The separation techniques that are used, are mostly chromatographic, either in gas or liquid phase, and the element-specific detectors are atomic spectrometric in absorption, emission or fluorescence mode. Atomic absorption spectrometry has been the most widely used detection technique because of its simplicity, sensitivity, and ease of operation. Liquid chromatography has great potential in the direct separation of organometals in solution without further derivatization, but there are still limitations in its interfacing with the furnace atomic absorption spectrometer. Plasma emission spectrometry has the advantage of multielement detection capability, for the simultaneous analyses of organometals in one sample. Such an advantage may be preferred over the high sensitivity detection of one element. Another area of development is the electrochemical detection system for use with the gas chromatograph or high-performance liquid chromatography. Once the separation has been achieved, the detection of the analytes can become specific. (See also W89-11686) (Lantz-PTT)
W89-11876

HUMIC ACID AND RELATED SUBSTANCES IN THE ENVIRONMENT.
National Water Research Inst., Burlington (Ontario). Research and Applications Branch.
J. Lawrence.
IN: Analysis of Trace Organics in the Aquatic Environment. CRC Press, Inc., Boca Raton, Florida. 1989. p 313-337, 4 fig, 5 tab, 139 ref.

Descriptors: *Humic substances, *Environmental quality, *Water analysis, *Humic acids, *Pollutant identification, *Chemical analysis, Fulvic acids, Phenols, Hydrocarbons, Carbohydrates, Organic matter, Organic compounds, Tannins, Lignin, Spectrophotometry, Colorimetry, Fate of pollutants, Fluorescence, Ultraviolet radiation.

Natural organic compounds, including humic substances (humic and fulvic acids) tannins, lignins, amino acids, phenols, carbohydrates, and hydrocarbons are widely distributed throughout the environment. These compounds occur abundantly throughout the aquatic environment in marshes, lakes, streams, rivers, and to a lesser extent the sea. They are complex mixtures of plant and animal origin in various stages of biological and chemical decomposition. These compounds are mainly responsible for the yellow-brown coloration of many waters and account for the major portion of dissolved organic matter in natural waters, often totalling 50-80% of the dissolved organic carbon. Due to the complex structure of aquatic organic matter, there is no known specific chemical reaction that can be used for analysis and with the wide variation in functional groups, molecular weight, and general composition, it is unlikely that such a reaction will ever be developed. In cases where humic and fulvic acids are present either alone or as the principal components, it is possible to determine gross concentrations by colorimetric, spectrophotometric, or thermogravimetric means. However, the dynamic nature of humic substances in ecosystems probably precludes the use of color as a useful method of determination. Ultraviolet and visible spectrophotometry have also been frequently used for the quantitation of aqueous humic substances. However, the uncharacteristic nature of the UV spectrum makes quantitation by this method very insensitive and the absorbance is strongly dependent on pH and metal-ion content. Fluorescence spectrophotometry has been used with some success for the analysis of aquatic humic solutions. Considerable similarities have been noted in the fluorescence spectra of organic acids from a wide variety of origins but several researchers have noted that fluorescence decreases with increasing molecular weight of the solute and decreasing pH of the solution. Tannins and lignins have most frequently been determined together by the molybdophosphoric/tungstophosphoric acid method using lignosulfonic acid as standard. (See also W89-11868) (Lantz-PTT)
W89-11877

PROCEEDINGS OF THE FIFTH CORPS CHEMISTS MEETING, 17-18 MAY 1988.
Army Engineer Waterways Experiment Station, Vicksburg, MS. Environmental Lab.
Available from the National Technical Information Service, Springfield, VA 22161 as ADA-208420, Price codes: A03 in paper copy, A01 in microfiche. Miscellaneous Paper EL-89-2, April 1989. Final Report. 27p, 3 fig. Compiled by Ann B. Strong, Karen F. Myers, and Glennard M. Warren.

Descriptors: *Conferences, *Chemical analysis, *Water quality control, Symposium, Pollutant identification, Sampling, Superfund.

This paper contains a summary of the Proceedings of the Fifth Corps Chemists Meeting. Presentations and discussions centered around laboratory validations, quality assurance/quality control for Superfund/DERP projects, laboratory inspections, analytical methodology, sampling techniques, and data management. (Author's abstract)
W89-11893

TOXICOLOGY--A PRIMER ON TOXICOLOGY PRINCIPLES AND APPLICATIONS.
Michigan State Univ., East Lansing. Dept. of Economics.
For primary bibliographic entry see Field 5C.
W89-11896

ETHYLENE THIOUREA IN MAINE GROUND WATER.
Maine Geological Survey, Augusta.
For primary bibliographic entry see Field 5B.
W89-11925

NEW METHOD FOR FIELD ANALYSIS OF SOILS CONTAMINATED WITH AROMATIC HYDROCARBON COMPOUNDS.
Goldberg-Zoino and Associates, Inc., Vernon, CT.
J. T. Griffith, G. A. Robbins, and T. M. Spittler.
IN: Proceedings of the FOCUS Conference on Eastern Regional Ground Water Issues, September 27-29, 1988, Stamford, Connecticut. National Water Well Association, Dublin, Ohio, 1988. p 223-248, 3 fig, 15 tab, 32 ref.

Descriptors: *Pollutant identification, *Path of pollutants, *Field tests, *Soil contamination, *Hydrocarbons, *Aromatic compounds, Organic compounds, Volatile organic compounds, Gas chromatography, Benzene, Toluene, Ethylbenzene, Xylenes.

Current methodologies used for field analysis of soils contaminated with hydrocarbon compounds are generally unreliable due to the complexity of soils and poor control of analytical conditions. A new method for field analysis of soils contaminated with volatile aromatic hydrocarbon compounds is developed utilizing aqueous extraction and static headspace analysis on a portable gas chromatograph. Soil samples are collected in volatile organic analysis (VOA) vials partially filled with distilled, deionized water. The water preferentially displaces the aromatic compounds from the soil which partition between the water and the headspace (air). The headspace is analyzed on a portable gas chromatograph. Henry's Law is used to determine the aqueous concentration through direct comparison to an aqueous standard. Soil concentrations are calculated from the measured aqueous concentration and the mass of soil and water using mass balance relationships. Temperature, headspace to sample volume ratios, and sample matrix characteristics affect the volatilization rate and equilibrium distribution of volatile organic compounds (VOCs) between air, water, and soil. These factors must be controlled to quantify VOC concentrations of soils using static headspace methods. Application of the methodology was evaluated for soils spiked with benzene, toluene, ethylbenzene, and o-xylene. Analyses were conducted on a portable gas chromatograph operating at an ambient temperature. Analyses, including extraction and equilibration time, required an average of 30 minutes to complete. Analyzed soil concentrations averaged within 6% of the predicted concentration with a standard deviation of 16.4. (See also W89-11916) (Author's abstract)
W89-11930

DETECTION OF SUBSURFACE GASOLINE CONTAMINATION IN NEW ENGLAND GLACIATED TERRAIN USING SOIL GAS SURVEYING.
Connecticut Univ., Storrs. Dept. of Geology and Geophysics.
G. A. Robbins, and M. R. Temple.
IN: Proceedings of the FOCUS Conference on Eastern Regional Ground Water Issues, September 27-29, 1988, Stamford, Connecticut. National Water Well Association, Dublin, Ohio, 1988. p 635-648, 4 fig, 3 tab, 9 ref.

Descriptors: *Pollutant identification, *Soil gases, *Soil contamination, *Glacial sediments, *Gasoline, *Groundwater pollution, Fate of pollutants, Hydrocarbons, Geohydrology, Permeability, Chemical analysis, Path of pollutants, Groundwater movement.

Theoretical, laboratory, and field studies are being conducted to quantify factors influencing the detection of subsurface gasoline contamination in glaciated New England soils using soil gas surveys. These studies are investigating how geohydrologic conditions and sampling techniques affect the measurement of subsurface vapor concentrations. Analyses would indicate that glaciated soils are characterized by low air permeability and vapor diffusivity brought about by high moisture content and abundant fines. This may explain in part observations of high vapor gradients in soil, and the presence of the more highly volatile and diffusive components of gasoline at older spills. Also, these characteristics may severely limit subsurface contamination detection outside of the immediate vicinity of the source. Experimental results on sampling techniques would indicate that measured vapor concentrations are highly dependent upon induced vacuum pressure, soil air oxygen level,

and instrumental flow rate response. Vapor sampling, in glaciated soils having low air permeability, will be highly sensitive to these effects. These effects appear to explain commonly observed concentration-time responses in conducting direct-line sampling. If sampling results are not corrected for vacuum pressure and flow rate, observed spatial concentration variations may not represent actual subsurface vapor concentration distributions, but instead spatial variations in soil air permeability. These factors imply that soil gas survey results in New England glaciated terrain can be readily misinterpreted, if viewed strictly on the basis of field concentration data, without due consideration for biases due to geohydrologic conditions and sampling technique. (See also W89-11916) (Author's abstract)
W89-11952

1989 ANNUAL BOOK OF STANDARDS. SECTION 11: WATER AND ENVIRONMENTAL TECHNOLOGY, VOLUME 11.01.
American Society for Testing and Materials, Philadelphia, PA.
For primary bibliographic entry see Field 2K.
W89-12000

1989 ANNUAL BOOK OF STANDARDS. SECTION 11: WATER AND ENVIRONMENTAL TECHNOLOGY, VOLUME 11.02.
American Society for Testing and Materials, Philadelphia, PA.
American Society for Testing and Materials, Philadelphia, Pennsylvania. 1989. 835p.

Descriptors: *Handbooks, *Pollutant identification, *Microbiological studies, *Sediments, *Water treatment, *Standards, *Water analysis, *Organic compounds, *Radioactivity, *Saline water, Classification, Tritium, Brines, Brackish water, Oil pollution, Corrosion, Filtration, Membranes.

The 1989 Annual Book of ASTM Standards consists of 67 volumes, divided among 16 sections. This is the second of two volumes of Section 11, Water and Environmental Technology, which are devoted to water standards. It contains formally approved ASTM standard classifications, guides, practices, specifications, test methods, and terminology and related material such as proposed standards. An ASTM standard represents a common viewpoint of those parties concerned with its provisions, namely, producers, users, consumers, and general interest groups. It is intended to aid industry, government agencies, and the general public. The use of an ASTM standard is purely voluntary. It is recognized that, for certain work or in certain regions, ASTM standard specifications may be either more or less restrictive than needed. The contents of this volume highlight: (1) organic constituents (concentration methods, general methods, specific constituents, and waterborne oils); (2) radioactivity (measurement of radioactivity, specific radionuclides, and heavy water); (3) saline and brackish waters, seawaters, and brines; (4) microbiological examination; (5) water-formed deposits; and (6) water treatment materials (chemicals, particulate ion-exchange materials, membrane filters, membranes and reverse osmosis, and reagent water). (See also W89-12000) (Lantz-PTT)
W89-12001

LASER/MICROBE BIOASSAY SYSTEM.
Technical Assessment Systems, Inc., Washington, DC.
I. C. Felkner, B. Worthy, T. Christison, C. Chaisson, and J. Kurtz.
IN: HWHM 88: Hazardous Wastes and Hazardous Materials. Proceedings of the 5th National Conference held April 19-21, 1988, Las Vegas, Nevada. 1988. p 81-84, 4 fig, 9 ref.

Descriptors: *Potable water, *Drinking water, *Toxicity, *Pollutant identification, *Bioassay, Bacteria, Measuring instruments, Lasers, Biological studies, Microbiological studies.

The LASER/MICROBE bioassay was developed to meet the needs of the Department of Defense and National Institutes of Environmental Health Sciences for a rapid detection system to detect low quantities of toxic contaminants in potable water. The bioassay system consists of the DAWN B Laser Photometer which makes 1200 measurements/sec at 15 unique angles and an isogenic set of Bacillus subtilis mutants. Toxicity to the bacteria is detected by differential light scattering (DLS) of the laser beam which measures the response of the bacteria in terms of light intensity at various angles > 180. The DLS pattern (liquid sample) shows the number of particles present, their size, shape and the distribution of particles. If the bacteria increase or decrease in size, the intensity vs. angles (DLS pattern) will shift. Therefore, shrinking, swelling or failure of the bacteria to divide over time are the measured parameters of toxicity. Concentration of the toxicant is determined by the level of response by the bacteria in a given sample. The time required for a complete assay is approximately 66 minutes (time required for untreated bacteria to divide twice in the absence of any toxicant). However, individual samples can be read and analyzed by the computerized system at a rate of one sample/min. (i.e., 5-10 concentrations of an aqueous sample are easily processed in just over an hour), generating data for: (1) identifying test material; (2) assessing concentration of test material; and (3) assessing whether test material is acutely or chronically toxic. (See also W89-12002) (Lantz-PTT)
W89-12015

GROUNDWATER QUALITY MONITORING IN A RISK ASSESSMENT FRAMEWORK.
Environmental Monitoring and Support Lab., Las Vegas, NV.
R. Rajogopal.
IN: HWHM 88: Hazardous Wastes and Hazardous Materials. Proceedings of the 5th National Conference held April 19-21, 1988, Las Vegas, Nevada. 1988. p 413-414.

Descriptors: *Network design, *Monitoring, *Groundwater quality, *Risk assessment, *Databases, *Water quality control, Information exchange, Public health, Hazardous wastes.

Questions such as why, what, where, when and how often to collect data play a central role in the development of a groundwater quality monitoring strategy for hazardous waste sites. Limited resources will not permit monitoring for many contaminants at the same frequency at all wells at all sites. Therefore, a resource allocation strategy is necessary to evaluate the answers for the previous type of questions. Numerous factors related to well design and construction, variations in groundwater quality over space and time, procedures associated with field and laboratory methods, cost of data collection, value of monitored information and perceptions of health risks from chemical exposure affect the development of a groundwater quality monitoring strategy. The impact of several of these factors on monitoring decisions is highlighted with findings derived from the analysis of three large groundwater quality data bases: the ambient groundwater quality data base of the U.S. Geological Survey (WATSTORE), the data base of the EPA maintained to meet the requirements of the Safe Drinking Water Act (MSIS) and the groundwater quality data base at selected hazardous waste sites maintained by the Environmental Monitoring Systems Laboratory (Las Vegas) of the EPA. (See also W89-12002) (Lantz-PTT)
W89-12057

U.S. EPA FIELD ANALYTICAL SCREENING PROJECT,
Ecology and Environment, Inc., Arlington, VA.
For primary bibliographic entry see Field 7A.
W89-12058

EVALUATION OF THE STANDARD ELUTRIATE TEST AS AN ESTIMATOR OF CONTAMINANT RELEASE AT THE POINT OF DREDGING,
Virginia Polytechnic Inst. and State Univ., Blacksburg.
D. D. Ludwig, J. H. Sherrard, and R. A. Amende.
Available from the National Technical Information Service, Springfield, VA 22161. Contract Report HL-88-1, August 1988. Final Report. 46p, 9 fig, 5 tab, 28 ref, 2 append. Department of the Army Contract DACW39-87-M-0329.

Descriptors: *Water pollution sources, *Pollutant identification, *Dredging, Water quality control, Pollution load, Chemical analysis, Water sampling, Heavy metals, Nutrients, Standard elutriate test.

Release of contaminants during dredged material disposal operations has long been the subject of environmental concern. The potential release of pollutants during the dredging process has, in recent years, come under the scrutiny of Federal and State regulatory agencies. The Standard Elutriate Test has proven to be a good estimator of soluble contaminant release for dredged material disposal operations. Data analyses and field studies were conducted by the US Army Engineer Waterways Experiment Station at four sites in the United Sates. A direct comparison was made between chemical concentrations in the test elutriate from sediment samples taken prior to dredging and corresponding concentrations in water samples taken at or near the point of dredging as sediment was being dredged. The Standard Elutriate Test satisfactorily predicted the release of soluble contaminants at or near the point of dredging at all four sites in this study. However, results indicated that the elutriate test appears to overestimate the release of organic materials, nutrients, and some heavy metals (mercury, manganese, iron, and chromium). (Lantz-PTT)
W89-12075

TECHNOLOGY ASSESSMENT OF FIELD PORTABLE INSTRUMENTATION FOR USE AT ROCKY MOUNTAIN ARSENAL.
Oak Ridge National Lab., TN. Analytical Chemistry Div.
R. A. Jenkins, W. H. Griest, R. L. Moody, M. V. Buchanan, and M. P. Maskarinec.
Available from the National Technical Information Service, Springfield, VA 22161, as AD-A198 302. Price codes: A06 in paper copy, A01 in microfiche. Final Report, March 1988. 105p, 1 fig, 5 tab, 2 append. Army Project Oder 0188. DOE Contract 1769-1334-A1.

Descriptors: *Water analysis, *Measuring instruments, *Pollutant identification, *Chemical analysis, *Metals, *Organic compounds, *Volatile organic compounds, Colorimetry, Rocky Mountain Arsenal, Inorganic compounds, X-ray fluorescence, Chromatography, Separation techniques.

An assessment was made of commercially available field instrumentation for analysis of samples at Rocky Mountain Arsenal. The analytes considered were metals, volatile organics, and semivolatile organics. Colorimetric tests for metals are recommended for screening, with positives being confirmed by microwave digestion followed by portable atomic absorption. A portable mercury monitor is recommended for this analysis. Portable X-ray fluorescence is recommended for higher levels of inorganics. For volatile organics, purge and trap and heated headspace followed by portable gas chromatography are recommended. For semivolatiles in soil, Soxtec (a quasi-soxhlet extractor) extraction and gas or thin layer chromatography are recommended. For semivolatiles is water, solvent extraction using a Mixxor (a field solvent-extraction device) is recommended. (Author's abstract)
W89-12079

DIRECT DETERMINATION OF PART-PER-BILLION LEVELS OF VOLATILE ORGANICS IN WATER AND SOIL SAMPLES USING GLOW DISCHARGE MASS SPECTROMETRY.
Oak Ridge National Lab., TN. Analytical Chemistry Div.
M. B. Wise, and M. R. Guerin.
Available from the National Technical Information Service, Springfield, VA 22161, as DE88-011389. Price codes: A03 in paper copy, A01 in microfiche. Report No. CONF-880768--1, (1988). 19p, 12 fig. DOE Contract DE-AC05-84OR21400.

Descriptors: *Water analysis, *Chemical analysis, *Pollutant identification, *Soil contamination, *Volatile organic compounds, *Mass spectrometry, Trace levels, Water pollution, Chemical analysis, Ions, Measuring instruments, Benzene, Trichloroethylene.

A low pressure glow discharge ion source has been constructed and interfaced with a quadrupole mass spectrometer for the direct monitoring of trace organic vapors in air. Important features of this ion source include a simple design, low cost, low maintenance, and the ability to sample air directly without the need for membranes, splitters, or capillary restrictors. Although the flow rate of air into the source is approximately 2 standard mL/second mTorr which reduces interferences caused by the formation of water cluster ions. Furthermore, the high flow rate of air into the ion source provides a simple and convenient means of purging volatile organics from water or soil samples directly into the mass spectrometer without additional apparatus or extensive sample preparation. Early studies with this system indicate that low part-per-billion levels of volatile organics such as benzene or trichloroethylene can be quantitatively determined in water and soil samples either by monitoring headspace above a sample or by direct purging. Analysis time of 2-5 minutes provides a high throughput of 10 or more samples per hour. (Author's abstract)
W89-12080

INSTALLATION RESTORATION PROGRAM PHASE II: CONFIRMATION/QUANTIFICATION, STAGE I.
Ecology and Environment, Inc., Lancaster, NY. Buffalo Corporate Center.
For primary bibliographic entry see Field 5B.
W89-12093

FIELD AND LABORATORY STUDY USING ADENYLATE ENERGY CHARGE AS AN INDICATOR OF STRESS IN MYTILUS EDULIS AND NEPHYTYS INCISA TREATED WITH DREDGED MATERIAL,
Environmental Research Lab., Narragansett, RI.
G. E. Zaroogian, P. F. Rogerson, G. Hoffman, M. Johnson, and D. Johns.
Available from the National Technical Information Service, Springfield, VA 22161, as ADA-198 107. Price codes: A06 in paper copy, A01 in microfiche. Technical Report D-88-4, June 1988. Final Report. 164p, 41 fig, 26 tab, 46 ref, 2 append.

Descriptors: *Pollutant identification, *Bioindicators, *Dredging, *Sediment contamination, *Mytilus, *Water pollution effects, *Polychaetes, Biological studies, Polychlorinated biphenyls, Adenosine diphosphate, Adenosine triphosphate, Field tests, Biochemical tests, Stress, Connecticut.

A study was conducted to test the applicability of adenylate energy charge (AEC) and adenine nucleotide pool concentrations as measures of biological response in the blue mussel, Mytilus edulis, and the marine polychaete, Nephtys incisa, after exposure in the laboratory and field to contaminated dredged material from Black Rock Harbor (BRH), Bridgeport, CT. Biological responses were measured in a laboratory dosing system that provided constant exposure concentrations of suspended BRH sediment ranging from 0 to 10 mg/L for M. edulis and 0 to 200 mg/L for N. incisa. In the field, biological responses were measured in both species sampled along a transect of stations at the Central Long Island Sound disposal site. Strong exposure-residue relationships measured in laboratory experiments indicated that selected contaminants in BRH sediment were biologically available. Tissue residue concentrations, particularly of persistent compounds such as polychlorinated biphenyls, were found to be closely related to exposure concentration. The biological responses evaluated in this report included the adenine nucleotide measures of adenosine triphosphate, adenosine diphosphate, adenosine monophosphate, adenylate pool, and AEC. These responses were measured in M. edulis and N. incisa exposed to BRH sediment in the laboratory and the field. The only significant laboratory response was a reduction in adenylate nucleotide concentrations measured in N. incisa 16 weeks postdisposal and were indicative of non-stressed organisms. (Lantz-PTT)
W89-12110

ACID MINE DRAINAGE, OCTOBER 1978-MAY 1988: CITATIONS FROM THE NTIS BIBLIOGRAPHIC DATABASE.
National Technical Information Service, Springfield, VA.
Available from National Technical Information Service, Springfield, VA22161 as PB88-865019, Price codes: N01 in paper copy, N01 in microfiche. June 1988. 68p. Supersedes PB87-859039.

Descriptors: *Acid mine drainage, *Bibliographies, *Pollutant identification, *Mine drainage, Water pollution control, Water pollution treatment, Chemical analysis.

This bibliography contains citations concerning laboratory and field analyses of acid mine drainage. Topics include site investigations and characterization, renovation and monitoring programs, contaminant treatment research, and control and abatement studies. Chemical analyses of affected areas, and terrestrial and aquatic ecosystems response evaluations are terrestrial and aquatic ecosystems response evaluations are also discussed. This updated bibliography contains 190 citations of which 10 are new entries to the previous edition. (Author's abstract)
W89-12145

OIL POLLUTION SAMPLING, DETECTION, AND ANALYSIS, JANUARY 1976-JANUARY 1988: CITATIONS FROM THE NTIS BIBLIOGRAPHIC DATABASE.
National Technical Information Service, Springfield, VA.
Available from National Technical Information Service, Springfield, VA 22161 as PB88-856232, Price codes: N01 in paper copy, N01 in microfiche. January 1988. 83p. Supersedes PB87-853636.

Descriptors: *Bibliographies, *Pollutant identification, *Oil pollution, *Monitoring, *Remote sensing, Chromatography, Spectroscopy, Sediment sampler, Marine environment, Tracers.

This bibliography contains citations concerning the monitoring and analysis of oil pollution resulting from production and transport operations. Descriptions and evaluations of monitoring methods and devices, tagging and tracing techniques, analytical techniques, including spectroscopy and chromatography, are among the topics reviewed. Remote sensing methods, and oil-laden sediment sampling and analyses are also considered. While the majority of the citation pertain to marine pollution, some attention is given to terrestrial aspects. Citations pertaining specifically to pollution effects on flora and fauna are excluded. This updated bibliography contains 251 citations of which 42 are new entries to the previous edition. (Author's abstract)
W89-12162

POLYCHLORINATED BIPHENYLS: OCCURRENCE IN SEDIMENTS AND SOILS, JANUARY 1977-JANUARY 1988: CITATIONS FROM THE SELECTED WATER RESOURCES ABSTRACTS DATABASE.
National Technical Information Service, Springfield, VA.
For primary bibliographic entry see Field 5B.
W89-12169

GROUND WATER POLLUTION: GENERAL STUDIES, DECEMBER 1984-JANUARY 1988: CITATIONS FROM THE NTIS BIBLIOGRAPHIC DATABASE.
National Technical Information Service, Springfield, VA.
For primary bibliographic entry see Field 5B.
W89-12172

5B. Sources Of Pollution

MICROBIAL TRANSFORMATIONS OF AZAARENES IN CREOSOTE-CONTAMINATED SOIL AND GROUND WATER: LABORATORY AND FIELD STUDIES.
Geological Survey, Denver, CO.
W. E. Pereira, C. E. Rostad, D. M. Updegraff, and J. L. Bennett.
Water Science and Technology WSTED4, Vol. 20, No. 11/12, p 17-23, 1988. 5 fig, 1 tab, 12 ref.

Descriptors: *Biotransformation, *Degradation products, *Creosote, *Groundwater pollution, *Path of pollutants, *Fate of pollutants, *Biodegradation, *Microbial degradation, *Soil contamination, Aerobic conditions, Aromatic compounds.

Azaarenes or aromatic nitrogen heterocycles are a class of compounds found in wood-preservative wastes containing creosote. The fate and movement of these compounds in contaminated aquifers is not well understood. Water quality studies in an aquifer contaminated with creosote near Pensacola, FL, indicated that groundwater was contaminated with several azaarenes and their oxygenated and alkylated derivatives, suggesting that these oxygenated compounds may be products of microbial transformation reactions. Accordingly, laboratory studies were designed to investigate the fate of these compounds. Under aerobic conditions, soil pseudomonads isolated from creosote-contaminated soil converted quinoline to 2(1H)quinolinone that subsequently was degraded to unknown products. A methanogenic consortium isolated from an anaerobic sewage digestor, in presence of groundwater and creosote-contaminated soil, converted quinoline, isoquinoline, and 4-methylquinoline to their respective oxygenated analogs. In addition, N, C, and O-methylated analogs of oxygenated azaarenes were identified by gas chromatography-mass spectrometry (GC-MS) in anaerobic cultures. Under the experimental conditions, 2-methylquinoline was biorefractory. Presence of similar biotransformation products in anaerobic cultures and contaminated groundwater from the Pensacola site provided further evidence that these compounds, in fact, microbial transformation products. Stable isotope labeling studies indicated that the source of the oxygen atom for this hydroxylation reaction under aerobic and anaerobic conditions was water. Whereas parent azaarenes are biodegradable in both anaerobic and aerobic zones, oxygenated an alkylated analogs are more biorefractory and, hence, persistent in anaerobic zones of contaminated aquifers. (Author's abstract)
W89-11072

LEGIONNAIRES DISEASES AND THE WATER ENVIRONMENT IN ISRAEL.
Hebrew Univ. of Jerusalem (Israel). Human Environment Sciences Div.
H. I. Shuval, B. Fattal, and H. Bercovier.
Water Science and Technology WSTED4, Vol. 20, No. 11/12, p 33-38, 1988. 2 tab, 6 ref.

Descriptors: *Human pathogens, *Legionella, *Bacteria, *Public health, *Israel, *Pathogens, Water supply, Bacterial analysis, Agronomy, Farms, Potable water, Pollutant identification, Cooling water, Stabilization ponds, Irrigation effects, Population exposure, Surface water, Fish ponds.

Using systematically evaluated methods, 39 strains of Legionella were isolated from 302 samples of water from surface sources, fishponds, cooling systems and wastewater stabilization ponds. Most isolations were made during the warm irrigation season (May to October). Legionella pneumophila was the most frequent species isolated. Evidence that Legionella can infect and survive for long periods, at low temperatures, in a natural aquatic protozoan (Acanthamoeba palestinensis), may provide a possible explanation for the over-wintering mechanism during which period that organisms are rarely identified in free form in water samples. Antibody levels to Legionnaires disease bacteria were determined on a total of 2,410 blood samples drawn from 1,355 individuals residing in rural agri-

cultural cooperative villages (kibbutzim). The population studied included irrigation and other water contact workers exposed to aerosolized water from sprinkler irrigation systems using clean water, wastewater and non-water contact individuals as controls. Water contact workers carried antibodies to Legionella pneumophila seven times more frequently than th non-water contact control group (2.8% vs. 0.4%). There was no difference between those exposed to sprinkler irrigation with clean water or wastewater effluent. It is concluded that under the conditions in Israel where Legionella spp. are ubiquitous in irrigation water sources, workers exposed to aerosols from sprinkler irrigation have a high occupational risks of infection with legionnaires disease bacteria. (Author's abstract)
W89-11074

BACTERIAL TRANSPORT IN FRACTURED ROCK: A FIELD-SCALE TRACER TEST AT THE CHALK RIVER NUCLEAR LABORATORIES.
Atomic Energy of Canada Ltd., Chalk River (Ontario). Chalk River Nuclear Labs.
D. R. Champ, and J. Schroeter.
Water Science and Technology WSTED4, Vol. 20, No. 11/12, p 81-87, 1988. 5 fig, 1 tab, 3 ref.

Descriptors: *Fracture permeability, *Environmental tracers, *Isotopic tracers, *Path of pollutants, *Groundwater pollution, *Geologic fractures, *Groundwater movement, Escherichia coli, Filtration, Field tests.

The potential for transport of bacteria by groundwater in fractured crystalline rock was assessed in a series of field-scale tracer tests. The breakthrough curves for injected Escherichia coli and 'non-reactive' particle tracers were computed with those for conservative inorganic and radioactive tracers. Rapid transport, relative to the conservative tracers, of both bacteria and non-reactive particles was observed. The first appearance of both was with, or slightly before, the conservative tracers for water movement. Removal of the bacteria and particles by filtration processes occurred and was quantified through the calculation of filter factors. The filtration process in this fracture system is similar to that found in a gravel aquifer. From the results it is concluded that particulate contaminant can be very rapidly transported in fracture systems and that continuing sources of contamination could lead to relatively high local concentrations of particulate contaminants compared with the average at any given distance from the source. It is also concluded that the use of traditional conservative tracers for water movement, to assess the potential for movement of particulate contaminants, could lead to significant underestimates of exposure to particulate contaminants due to consumption of water from water recovery wells located in fractured media. (Author's abstract)
W89-11080

FUNGI FROM POTABLE WATER: INTERACTION WITH CHLORINE AND ENGINEERING EFFECTS.
West Chester Univ. of Pennsylvania. Dept. of Biology.
For primary bibliographic entry see Field 5A.
W89-11090

KINETICS OF METHANE-OXIDIZING BIOFILMS FOR DEGRADATION OF TOXIC ORGANICS.
Washington Univ., Seattle. Coll. of Forest Resources.
S. E. Strand, R. M. Seamons, M. D. Bjelland, and H. D. Stensel.
Water Science and Technology WSTED4, Vol. 20, No. 11/12, p 167-173, 1988. 8 fig, 1 tab, 25 ref.

Descriptors: *Methane, *Biofilms, *Water pollution treatment, *Groundwater pollution, *Biodegradation, *Fate of pollutants, *Organic solvents, Solvents, Kinetics, Toxicity, Water quality control, Water pollution control, Oxidation, Chlorinated hydrocarbons, Path of pollutants.

Of those chlorinated solvents known to contaminate groundwaters, those of particular concern are trichloroethylene and 1,1,1-trichloroethane, due to their carcinogenicity and relative resistance to biological degradation. The distribution, fate and public health consequences of these compounds in the groundwater are reviewed. The kinetics of methane-oxidizing bioreactors for the degradation of toxic organics are modeled. Calculations of the fluxes of methane and toxic chlorinated hydrocarbons were made using a biofilm model. The model simulates the effects of competition by toxics and methane on their enzymatic oxidation of the methane monooxygenase. Dual-competitive substrate/diffusion kinetics were sued to model biofilm cometabolism, integrating three model equations. The model predicts that methane fluxes will be relatively unaffected by surface toxic concentrations less than five times the half-saturation constant for the toxic. The rates were found to be moderately sensitive to variations in the diffusivity of the toxic compound and less sensitive to methanotrophic biomass, half-saturation and to the surface oxygen concentration was as expected from conventional biofilm kinetics: no effect until oxygen fell low enough to limit the biofilm depth. (Friedmann-PTT)
W89-11092

DEGRADATION OF TRICHLOROETHYLENE BY METHANOTROPHIC BACTERIA IN A LABORATORY COLUMN OF SATURATED AQUIFER MATERIAL.
Washington Univ., Seattle. Coll. of Forest Resources.
For primary bibliographic entry see Field 5G.
W89-11093

RECOMBINANT DNA PLASMID TRANSMISSION TO INDIGENOUS ORGANISMS DURING WASTE TREATMENT.
Drexel Univ., Philadelphia, PA. Dept. of Bioscience and Biotechnology.
M. A. Gealt.
Water Science and Technology WSTED4, Vol. 20, No. 11/12, p 179-184, 1988. 42 ref. EPA Grants R810049 and R812362.

Descriptors: *Nucleic acids, *Plasmids, *Genetic pollution, *Path of pollutants, *Biological wastewater treatment, *Wastewater treatment, Bacteria, Genetic engineering, Viruses, Model studies, Fate of pollutants, Environmental engineering, Environmental protection, Biological properties.

The means by which DNA plasmids, in the form of genetically engineered DNA sequences (GEDS), are transmitted to indigenous organisms via a wastewater treatment process is reviewed, and experiments were performed to trace GEDS mobilization. This gene transfer, which is also shown to occur in a laboratory-scale facility under conditions that model treatment processes (about 20 L capacity), depends on the presence of bacteria containing conjugative plasmids, many of which are indigenous to wastewater. Sensitive detection of GEDS transfer requires the use of DNA-DNA hybridization. For the current experiment, non-bacterial genes, pHSV106, which contains the thymidine kinase (tk) gene of herpes simplex virus, were used to trace GEDS mobilization. The acquisition of plasmid-encoded characteristics by recipients in di-parental coincubation with the isolated mobilizers was observed. In tri-parental coincubations containing a pBR325-plasmid donor strain, naturally occurring mobilizer strains have shown the capability to participate in the mobilization of recombinant DNA. The plasmids resulting from these tri-parental coincubations indicated not only that recombinational rearragements frequently were necessary to establish plasmid stability, but also that plasmid stability was a reasonably common event. The ecological fate of the altered DNA must continue to be analyzed and environmental engineering methods must be developed to contain the spread of GEDS. (Friedmann-PTT)
W89-11094

DETERMINATION OF ACTIVE BIOMASS.
Technical Univ. of Denmark, Lyngby. Dept. of Sanitary Engineering.
For primary bibliographic entry see Field 5D.
W89-11099

INTERACTIONS BETWEEN FREE-LIVING AMOEBAE AND LEGIONELLA IN THE ENVIRONMENT.
Strasbourg-1 Univ. (France). Faculte de Pharmacie.
For primary bibliographic entry see Field 5A.
W89-11102

CORRELATIONS OF THE PROTOZOA, CRYPTOSPORIDIUM AND GIARDIA, WITH WATER QUALITY VARIABLES IN A WATERSHED.
Arizona Univ., Tucson. Dept. of Microbiology and Immunology.
J. B. Rose, H. Darbin, and C. P. Gerba.
Water Science and Technology WSTED4, Vol. 20, No. 11/12, p 271-276, 1988. 3 tab, 16 ref.

Descriptors: *Cryptosporidium, *Giardia, *Turbidity, *Pollutant identification, *Protozoa, *Ecological distribution, *Parasites, *Coliforms, *Water analysis, Statistical analysis, Microorganisms, Path of pollutants, Bacterial analysis, Correlation analysis, Watersheds, Catchment areas, Spores, Water pollution effects.

A watershed in the western United States was surveyed biweekly for a year for the protozoa Cryptosporidium and Giardia. Parasite samples were collected using filtration of 200-1000 L of water, eluted by washing the filter, concentrated and clarified with density gradients. Oocyst and cysts were detected using monoclonal antibodies, in a direct or indirect immunofluorescent assay. The organisms were enumerated on membrane filters using epi-fluorescent microscopy. Number of organisms per liter of water were then calculated. Grab samples were analyzed for total and fecal coliform concentrations as well as turbidities. After log 10 (y + 1.0) transformations, Pearson's correlation coefficients were derived for each variable against all others. From 39 samples, Cryptosporidium and Giardia were detected in 20 and 12 of the samples, respectively, and oocyst concentrations were approximately 10 times higher than cyst levels. The river downstream from the lake ran through an area concentrated with cattle pasture and had the greater numbers of both parasites (1.09 oocysts and 0.22 cysts/L). The lake, although receiving sewage effluents, may have also had lower levels (0.58 oocysts and 0.08 cysts/L) because of dilution and sedimentation. Coliform levels ranged from 0.12 to 75 CFU/100 ml while fecal coliform levels were slightly lower. Turbidity averaged 55 NTU at the river and 48 NTU at the lake. Correlation coefficients were derived for all variables. Giardia concentrations were significantly correlated to Cryptosporidium concentrations with an r value of 0.778, significant at the 99% confidence level. No other correlations were observed between Giardia and total or fecal coliforms or turbidities nor between Cryptosporidium levels and total or fecal coliforms or turbidities. Neither bacterial indicator organisms nor turbidity are reliable predictors for the absence of enteric protozoa in the study watershed. (Author's abstract)
W89-11107

VIRUS SURVIVAL AND TRANSPORT IN GROUNDWATER.
Agricultural Research Service, Riverside, CA. Salinity Lab.
M. V. Yates, and S. R. Yates.
Water Science and Technology WSTED4, Vol. 20, No. 11/12, p 301-307, 1988. 4 fig, 33 ref.

Descriptors: *Viruses, *Path of pollutants, *Groundwater pollution, *Hydrologic models, *Septic tanks, *Drinking water, *Water pollution sources, Human pathogens, Model studies, Potable water, Sampling, Groundwater movement, Artesian wells, Soil water.

Viruses may be responsible for up to 50% of waterborne disease in the U.S., with septic tanks being a major source of viruses in soils and groundwater. A model is developed that could be used to estimate safe distances between septic tanks, or other sources of contamination, and drinking water wells. The model was based on groundwater flow characteristics and the length of time that viruses remain infective in the subsurface environment. Water samples were collected from 71 continuously pumping municipal drinking water wells. Viruses were inoculated into the water samples, and the rate at which the viruses were inactivated was calculated for each sample. The inactivation rates were determined to be spatially correlated by calculating a semivariogram. Kriging, a geostatistical technique, was used to estimate virus inactivation rates at unsampled locations using the measured values at nearby locations. The measured and kriged virus inactivation rates were used in conjunction with the regional groundwater flow characteristics to calculate septic tank setback distances over a city-wide area. The setback distance was defined as the distance required for a 7-log reduction in virus number in the time that the water traveled from the source of contamiantion to a drinking water well. The model has been extended to account for alterations in the flow filed caused by presence of pumping wells. Setback distances of less than 15 m to over 300 m have been calculated using these models. The results of this research may be useful for community planning purposes. (Author's abstract)
W89-11111

COMPARATIVE STUDIES ON THE SURVIVAL OF INDICATOR ORGANISMS AND PATHOGENS IN FRESH AND SEA WATER.
Newcastle upon Tyne Univ. (England). Dept. of Civil Engineering.
L. M. Evison.
Water Science and Technology WSTED4, Vol. 20, No. 11/12, p 309-315, 1988. 6 tab, 5 ref.

Descriptors: *Fate of pollutants, *Viruses, *Pathogens, *Seawater, *Bioindicators, *Survival, Bacteria, Water temperature, Microorganisms, Comparison studies, Statistical analysis, Streptococcus, Shigella, Salmonella, Nutrients, Salinity, Solar radiation, Bacterial analysis, Water analysis.

A comprehensive series of experiments were conducted in which the survival characteristics of a range of indicator bacteria, pathogenic bacteria nd bacteriophages were compared in fresh and seawater in the light, and at a range of temperatures, nutrient concentrations and salinities in the dark. Aliquots of filtered seawater or freshwater were inoculated with sewage or pure cultures. The effect of light was investigated in a solar simulator in which the light intensity from 400 W medium-pressure mercury iodide discharge lamps could be adjusted by altering the distance between the beaker and the bulbs. The temperature was maintained at 15C in all samples for all light experiments. The effect of temperature was measured in fresh and seawater in 1 l beakers in the dark, over the range of 2, 5, 10, 15, 20 and 25 degrees C. Organism survival was studied in E. coli, fecal streptococci, maroon fecal streptococci, Salmonella typhimurim 12, 12a and 110, S. anatum, Shigella sonnei, Sh. flexneri, Yersinia enterocolitica, Campylobacter fetus, Coliphages MS 2 and f2. The data showed that in the light, the survival of E. coli was very poor compared to that of Salmonellae. In the light, survival was best in freshwater, but in the dark, survival in seawater was usually better. A linear relationship was demonstrated for T sub 90 and light intensity, and log T sub 90 and temperature, but non-linear responses occurred for a range of salinities and nutrient concentrations. (Friedmann-PTT)
W89-11112

NITROGEN-FIXING HETEROTROPHIC BACTERIA IN COASTAL WATERS: A COMPARISON OF THE CONTRIBUTION MADE BY SEWAGE EFFLUENT IN A TEMPERATE AND A TROPICAL ENVIRONMENT.
Lancaster Univ. (England). Dept. of Biological Sciences.
K. Jones, and M. Betaieb.
Water Science and Technology WSTED4, Vol. 20, No. 11/12, p 323-328, 1988. 6 tab, 10 ref.

Descriptors: *Temperate zone, *Fate of pollutants, *Sewage bacteria, *Coastal waters, *Tropical regions, *Heterotrophic bacteria, *Nitrogen fixing bacteria, Enterobacter, Microbial degradation, Biodegradation, Bacteria, Comparison studies, Path of pollutants, Survival, Wastewater outfall, Klebsiella.

Using identical techniques, a comparison is made between the distribution and survival of heterotrophic nitrogen-fixing bacteria from sewage in cold seawater of Morecambe Bay, U.K., and warm seawater of Oahu, Hawaii, U.S.A. In the colder seawater, the predominant nitrogen-fixing bacteria are salinity-tolerant strains of Enterobacteriaceae (mainly Klebsiellas) that come from sewage effluent discharged into the rivers and estuaries flowing into the bay. In the inshore warmer waters of Oahu, similar numbers of heterotrophic nitrogen-fixing bacteria are found but, although most are salinity-tolerant, they are not predominantly Enterobacteriaceae. Sewage effluent from Honolulu discharged into the sea is rapidly dispersed and the bacteria quickly killed by UV light that penetrates into the clear water. In Morecambe Bay, bacteria are found much further out to sea and they survive for much longer periods because sunshine levels are relatively low and light penetration is inhibited by high turbidity from suspended solids. It is concluded that salinity-tolerance does not appear to have a high survival value for the nitrogen-fixing Klebsiellas; there is little evidence, in fact, that salinity has any effect on the survival of enteric bacteria in general. The main effect of salinity on K. pneumoniae is to slow down the rate of growth and nitrogen fixation. (Author's abstract)
W89-11114

DISINFECTION, RECONTAMINATION, AND REGROWTH OF INDICATOR BACTERIA IN A WASTEWATER SLUDGE HEAT TREATMENT SYSTEM.
Hawaii Univ., Honolulu. Water Resources Research Center.
For primary bibliographic entry see Field 5D.
W89-11115

F-SPECIFIC RNA-BACTERIOPHAGES AS MODEL VIRUSES IN WATER HYGIENE: ECOLOGICAL ASPECTS.
Rijksinstituut voor de Volksgezondheid en Milieuhygiene, Bilthoven (Netherlands). Lab. for Water and Food Microbiology.
For primary bibliographic entry see Field 5A.
W89-11124

PHENOTYPE VARIATION WITHIN KLEBSIELLA PNEUMONIAE: A TOOL TO TRACE SOURCES OF CONTAMINATION IN SURFACE WATER.
National Bacteriological Lab., Stockholm (Sweden).
For primary bibliographic entry see Field 5A.
W89-11129

MARINE HYDROCARBON-DEGRADING MICROORGANISMS: COMMUNITY STRUCTURE AND BIOMASS DETERMINATION.
Oklahoma Univ., Norman. School of Civil Engineering and Environmental Science.
M. Carpenter, and J. Robertson.
Water Science and Technology WSTED4, Vol. 20, No. 11/12, p 433-435, 1988. 2 tab, 5 ref.

Descriptors: *Oil pollution, *Fate of pollutants, *Water pollution treatment, *Biodegradation, *Hydrocarbons, *Marine environment, *Microbial degradation, *Algae, Microorganisms, Oil wastes, Bacteria, Harbors, Biomass, Monitoring, Bilge, Species composition, Fungi.

A mixed community of microorganisms was collected from the harbor at the San Diego Navy Base and was monitored in a test ecosystem containing an oily bilge waste obtained from off-loading ships. The cultures were examined in the presence and absence of the algae, to determine if the algae could enhance the degradation of the oily waste by providing oxygen and possibly a nutrient source from dying algae for the bacterial community. The bilge wastes obtained contained, within detectable limits, kerosene, bromoform, tetrachloroethylene, toluene, benzene, methylene chloride and phenol. Mixed organism communities were exposed to the waste for 6 weeks in a 12 h light, 12 h dark cycle and biomass measurements were recorded before and after exposure. A comparison was made of several media designed for use in the most probable number (MPN) determination of petroleum-degrading microorganims. The dominant algae prior to hydrocarbon exposure were Oscillatoria sp., blue-green filamentous algae, and lesser amounts of Chlamydomonas sp. and Chlorella sp. After six weeks of exposure to bilge, Chlamydomonas sp. and Chlorella sp. had increased by a factor of 20 (in phenol-treated cultures) and 55 (in waste-phenol treated cultures). The analysis of the chlorophylls indicated a significant increase in all chlorophylls. The biomass data indicated that mixed communities containing algae, fungi, and bacteria appear capable of growth on the bilge waste, although the community structure changes significantly. (Friedmann-PTT)
W89-11130

COMPARISON OF VIRUS SURVIVAL IN FRESHWATER SOURCES.
Arizona Univ., Tucson. Dept. of Nutrition and Food Science.
For primary bibliographic entry see Field 5F.
W89-11139

EFFECT OF ENVIRONMENTAL VARIABLES ON ENTERIC VIRUS SURVIVAL IN SURFACE FRESHWATERS.
Health Effects Research Lab., Cincinnati, OH.
C. J. Hurst.
Water Science and Technology WSTED4, Vol. 20, No. 11/12, p 473-476, 1988. 2 fig, 2 tab, 6 ref.

Descriptors: *Enteroviruses, *Fate of pollutants, *Pathogens, *Path of pollutants, Survival, Surface water, Solar radiation, Lakes, Rivers, Rotaviruses, Ultraviolet radiation.

Enteric viruses are often found to be present in natural surface freshwaters. Several types of contributing sources to this contamination are reviewed from six previously published studies. The stability of enteric viruses had been examined in rivers, streams, lakes and ponds. Viral inactivation rates were expressed in terms of log base 10 units/day, representing the entire period of sample observations; these rates were then analyzed by linear regression as being the dependent variable versus incubation temperature. Rotaviruses appeared to be much more stable in fresh surface waters as compared with enteroviruses. High levels of turbidity seemed to reduce the inactivating effects of sunlight upon viruses exposed in shallow trays. This might have been caused by turbidity reducing penetration of UV radiation through the water. (Friedmann-PTT)
W89-11140

BIODEGRADATION AND GROWTH KINETICS OF ENRICHMENT ISOLATES ON BENZENE, TOLUENE, AND XYLENE.
Sybron Chemicals, Inc., Salem, VA.
C. D. Goldsmith, and R. K. Balderson.
Water Science and Technology WSTED4, Vol. 20, No. 11/12, p 505-507, 1988. 4 fig, 1 tab.

Descriptors: *Benzenes, *Toluene, *Xylenes, *Fate of pollutants, *Biodegradation, *Biodegradation, *Growth kinetics, Aerobic conditions, Substrates, Growth media, Microbial degradation, Culturing techniques, Groundwater pollution, Model studies, Cleanup.

The biodegradation rates and growth kinetics were determined for the aromatic compounds benzene, toluene, and para-xylene through batch cultures. Substrate volatilization was minimized and aerobic

conditions maintained. Plots were made of substrate loss versus time and of solution absorbance (biomass) at 525 nm versus time. The linear portion of these plots were used to obtain utilization and growth rates at several substrate concentrations. Results showed little difference among the biokinetic utilization constants of the three compounds tested. Toluene, however, demonstrated a slightly higher maximum utilization rate, and first order substrate utilization rate. Toluene was utilized most rapidly. Benzene and para-xylene are utilized at similar rates. These data can be used in groundwater modeling and designing biological remediation systems. (Friedmann-PTT)
W89-11148

MODELING MICROBIAL TRANSPORT IN POROUS MEDIA.
Montana State Univ., Bozeman. Inst. for Biological and Chemical Process Analysis.
A. B. Cunningham, D. J. Crawford, and W. G. Characklis.
Water Science and Technology WSTED4, Vol. 20, No. 11/12, p 509-511, 1988. 1 fig, 2 ref. USGS grant 14-08-0001-G1284.

Descriptors: *Fate of pollutants, *Model studies, *Path of pollutants, *Porous media, *Groundwater pollution, *Capillary water, *Microorganisms, Biodegradation, Differential equations, Advection, Hydrodynamics, Nutrients, Biofilms.

A method for modeling the transport of microbial cells and nutrients in saturated porous media is presented. Model applications include analysis and mitigation of porous media biofouling, and analyses of schemes for in-situ biodegradation of organic groundwater contaminants. The model concept is based on the solution of the advection/dispersion equation, which treats the change in solute concentration with time as being the sum of concentration change due to advection, concentration change due to hydrodynamic dispersion, and concentration change due to solute adsorption or reaction with surroundings. Solution of the differential equations describing these mass balances requires characterization of pore space geometry. The proposed modeling approach considers the porous media within a control volume to be composed of a series of circular conduits of diameter equal to the average effective pore channel width. The model is capable of simulation variations in nutrient concentration as well as biofilm accumulation with time and position along the flow path. (Friedmann-PTT)
W89-11149

GROUND WATER MONITORING FOR TEMIK (ALDICARB) IN FLORIDA.
Florida Univ., Gainesville. Dept. of Environmental Engineering Sciences.
For primary bibliographic entry see Field 5A.
W89-11163

SPREADSHEET WATERSHED MODELING FOR NONPOINT-SOURCE POLLUTION MANAGEMENT IN A WISCONSIN BASIN.
Geological Survey, Madison, WI.
For primary bibliographic entry see Field 5G.
W89-11169

MANGANESE OXIDATION RELATED TO THE RELEASES FROM RESERVOIRS.
Tennessee Technological Univ., Cookeville. Dept. of Civil Engineering.
J. A. Gordon.
Water Resources Bulletin WARBAQ, Vol. 25, No. 1, p 187-192, February 1989. 8 fig, 13 ref.

Descriptors: *Path of pollutants, *Water pollution treatment, *Reservoirs, *Manganese, *Reservoir releases, Oxidation, Tennessee, Duck River, Normandy Dam.

Stratified reservoir waters frequently contain objectionable quantities of dissolved Mn. The oxidation and removal of dissolved Mn during transport in the Duch River below Normandy Dam, Tennessee, was shown to be much more rapid than expected from chemical oxidation. Oxidation took place in only a day of travel time rather than months or years. Laboratory studies showed that removal was associated with a slime found on rock surfaces below the dam and led to the development of column technology as a possible method of treating natural waters containing Mn. Hydraulic loadings on the columns in the range of 390-780 cu m/hr-ha accomplished a 90% removal rate of soluble Mn over an influent concentration range of 2-15 mg/L. (Author's abstract)
W89-11175

PORE WATER PROFILES AND EARLY DIAGENESIS OF MN, CU, AND PB IN SEDIMENTS FROM LARGE LAKES.
Michigan State Univ., East Lansing. Dept. of Geological Sciences.
For primary bibliographic entry see Field 2H.
W89-11187

PCBS AND PAHS AS TRACERS OF PARTICULATE DYNAMICS IN LARGE LAKES.
Minnesota Univ., Minneapolis. Dept. of Civil and Mineral Engineering.
For primary bibliographic entry see Field 2H.
W89-11188

DEGRADATION OF ATRAZINE AND RELATED S-TRIAZINES.
Kansas State Univ., Manhattan. Dept. of Chemical Engineering.
L. E. Erickson, and K. H. Lee.
CRC Critical Reviews in Environmental Control CCECAU, Vol. 19, No. 1, p 1-14, 1989. 6 fig, 2 tab, 56 ref.

Descriptors: *Limnology, *Triazine pesticides, *Fate of pollutants, *Soil chemistry, *Degradation, *Literature review, Agricultural chemicals, Herbicides, Atrazine, Weed control, Corn, Path of pollutants, Soil contamination, Soil water, Microbial degradation, Biodegradation, Bioenergetics, Temperature effects, Solubility, Detoxification, Activated carbon.

Atrazine (CIET) and other s-triazines are widely used for weed control in the production of corn and other crops. This article reviews the degradation of these herbicides and their persistence in soil and water systems. One of the pathways of CIET, simazine, and propazine detoxification is through the formation of hydroxyl analogs such as hydroxyatrazine (IEOT) from CIET. Dealkylation appears to be the first step in the microbial degradation of chloro-s-triazine herbicides. There appear to be several pathways for subsequent metabolism of the dethylsimazine and deethylatrazine produced by the first dealkylation of CIET. One of the features of s-triazine herbicides is their persistence in the soil. It is highly desirable that they be effective during the entire growing season of the crop of interest. However, if they persist into the following growing season, this may limit the choice of crops that can be grown on the land the year after pesticide application. IEOT is bound strongly to soil and has very low water solubility. Microbiological activity appears to contribute to the disappearance of CIET and other s-triazines from soil. The degradation rate of CIET increases with temperature. The rate approximately doubles with each 10-degree increase in temperature in the range from 10 to 30 C. The moisture content of the soil also influences the degradation of CIET; degradation is slowest in dry soils. Where CIET is still present in the soil when a new crop that is sensitive to CIET is to be planted, granular activated carbon can be used to protect the new crop. (Sand-PTT)
W89-11197

DETERMINATION OF SEDIMENT COMPOSITION AND CHRONOLOGY AS A TOOL FOR ENVIRONMENTAL IMPACT INVESTIGATIONS.
Consiglio Nazionale delle Ricerche, Padua (Italy). Ist. di Chimica e Tecnologia dei Radioelementi.
For primary bibliographic entry see Field 5A.
W89-11215

DISSOLVED NICKEL AND COBALT IN THE AQUATIC ENVIRONMENT AROUND MONACO.
International Lab. of Marine Radioactivity, Monaco-Ville (Monaco).
For primary bibliographic entry see Field 2K.
W89-11217

CONTAMINANT TRANSPORT IN A SINGLE FRACTURE: PERIODIC BOUNDARY AND FLOW CONDITIONS.
Georgia Inst. of Tech., Atlanta. School of Geophysical Sciences.
R. P. Lowell.
Water Resources Research WRERAO, Vol. 25, No. 5, p 774-780, May 1989. 4 fig, 25 ref. Georgia Geologic Survey Contract 707-690351.

Descriptors: *Solute transport, *Fracture permeability, *Path of pollutants, *Boundary conditions, *Groundwater movement, *Geologic fractures, Fluid mechanics, Physical properties, Uniform flow, Oscillatory waves, Geohydrology, Flow velocity, Flow characteristics.

The effects of time-periodic inlet contaminant concentration and groundwater flow velocity on contaminant transport in a single, planar fracture, imbedded in a relatively impermeable rock matrix, were investigated. The calculations show that the contaminant propagates as a damped traveling wave into the matrix and along the fracture. If longitudinal dispersion is neglected, penetration of the wave into the matrix and fracture depends upon the input frequency. Under uniform flow conditions, a daily oscillation penetrates into the matrix and fracture approximately 1 cm and 1 m, respectively. An annual oscillation penetrates approximately 10 cm and tens of meters for the matrix and fracture, and upon the flow velocity. Because longitudinal dispersion acts to further damp the amplitude of the traveling waves, these results give maximum penetration distances for the waves. If the flow velocity also has a small, time-periodic component, the downstream contaminant oscillations are virtually unchanged unless the inlet condition and flow have the same frequency. In this case, a dc transport of contaminant transport occurs that may have an amplitude as large as one-half of the magnitude of the velocity oscillation. These results indicate that in the absence of resonance, negligible error occurs in treating contaminant transport using mean inlet and flow conditions rather than more realistic time-varying one. Observations of oscillations, however, can be used to provide useful information on rock and fracture transport properties. (Author's abstract)
W89-11248

RELATIONSHIP OF CATCHMENT TOPOGRAPHY AND SOIL HYDRAULIC CHARACTERISTICS TO LAKE ALKALINITY IN THE NORTHEASTERN UNITED STATES,
Geological Survey, Trenton, NJ. Water Resources Div.
For primary bibliographic entry see Field 2K.
W89-11253

FLUXES OF N2O AT THE SEDIMENT-WATER AND WATER-ATMOSPHERE BOUNDARIES OF A NITROGEN-RICH RIVER.
Massachusetts Inst. of Tech., Cambridge. Ralph M. Parsons Lab. for Water Resources and Hydrodynamics.
H. F. Hemond, and A. P. Duran.
Water Resources Research WRERAO, Vol. 25, No. 5, p 839-846, May 1989. 4 fig, 2 tab, 39 ref. NSF Grant CEE-8108184.

Descriptors: *Wastewater outfall, *Path of pollutants, *Nitrogen oxide, *Nitrogen compounds, *Sediment-water interfaces, *Air-water interfaces, *Path of pollutants, *Stream pollution, Effluents, Fluctuations, Seasonal variation, Cycling nutrients, Bottom sediments, Water column, Fate of pollutants.

The biogeochemistry of N2O was studied in a reach of a small river in Massachusetts that re-

ceives wastewater treatment plant effluent. Fluxes of N2O across the sediment-water and water-air interfaces were measured using a mass-balance approach in which gas exchange coefficients were measured in situ. The observed atmospheric flux averaged 0.25 mg N2O /sq m-h, and was among the highest reported fluxes for aquatic systems on a per-area basis, although the significance of such rivers as global N2O sources may not be large. The largest fraction of the N2O released to the atmosphere was produced in the treatment plant per se. During the cold season, N2O was produced in the river sediment; during the warm season, the sediment was a sink for N2O. Throughout the year, water column production was minimal. During the season when N2O was consumed by the sediment, the benthic N2O flux could be predicted by a simple oxygen penetration depth model. (Author's abstract)
W89-11254

DISCRETE KERNEL METHOD OF CHARACTERISTICS MODEL OF SOLUTE TRANSPORT IN WATER TABLE AQUIFERS,
Colorado Univ. at Boulder. Dept. of Civil, Environmental, and Architectural Engineering.
T. H. Illangasekare, and P. Doll.
Water Resources Research WRERAO, Vol. 25, No. 5, p 857-867, May 1989. 10 fig, 35 ref. NSF Grant ECS-851986.

Descriptors: *Unconfined aquifers, *Path of pollutants, *Groundwater movement, *Hydrologic models, *Solute transport, *Porous media, *Multiphase flow, *Model studies, Aquifers, Geohydrology, Simulation, Differential equations, Flow velocity, Advection, Diffusivity.

A simulation model of two-dimensional solute transport in water table aquifers is developed. The linearity of the governing partial differential equation of groundwater flow is exploited by using the discrete kernel approach that has been successfully employed previously in groundwater flow modeling. With this approach, the flow velocities resulting from different pumping and injection schemes can be efficiently computed. The conventional implementation of the method of characteristics is improved using an influence area particle tracking scheme that avoids the oscillations and step jumps of breakthrough curves. The concept of a porous medium consisting of mobile and immobile zones is introduced into the solution of the two-dimensional advection dispersion equation. When model results were compared with those generated with an analytical solution and with a conventional method of characteristics model, the two-zone model resulted in an earlier breakthrough, higher peak concentration and tailing. This behavior may not necessarily occur for other parameter combinations. (Friedmann-PTT)
W89-11256

REDOX-CONTROLLED MULTIPLE-SPECIES REACTIVE CHEMICAL TRANSPORT: 1. MODEL DEVELOPMENT.
California Univ., Berkeley. Dept. of Materials Science and Mineral Engineering.
For primary bibliographic entry see Field 2K.
W89-11257

REDOX-CONTROLLED MULTIPLE-SPECIES REACTIVE CHEMICAL TRANSPORT: 2. VERIFICATION AND APPLICATION.
California Univ., Berkeley. Dept. of Materials Science and Mineral Engineering.
For primary bibliographic entry see Field 2K.
W89-11258

ESTIMATING CONSTITUENT LOADS.
Geological Survey, Reston, VA.
For primary bibliographic entry see Field 2J.
W89-11261

HYDRODYNAMIC DISPERSION AT THE LOCAL SCALE OF CONTINUUM REPRESENTATION.
Atomic Energy of Canada Ltd., Chalk River (Ontario). Chalk River Nuclear Labs.
G. L. Moltyaner.
Water Resources Research WRERAO, Vol. 25, No. 5, p 1041-1048, May 1989. 6 fig, 18 ref.

Descriptors: *Path of pollutants, *Dispersion, *Plumes, *Hydrodynamics, *Diffusivity, *Groundwater movement, *Radioactive tracers, *Porous media, Mathematical studies, Field tests, Percolation, Observation wells, Piezometers, On-site tests, Aquifers, Ontario, Quantitative analysis, Mathematical equations.

Two types of measurement devices, a fully penetrating dry observation well with a gamma ray detector and a multilevel piezometer with a 7.5 cm-long screen, were used for measurement of radiotracer concentrations in three natural gradient dispersion tests performed at Twin Lake aquifer, Chalk River, Ontario over 20, 40, and 260 m distances. The devices are classified according to the method of measurement of tracer concentration as through-the-wall and mixing-cup measurement devices. The weighting function associated with the through-the-wall measurement device is defined by considering the process of interaction of gamma radiation with aquifer materials in a laboratory experiment and is found to follow an exponential attenuation law. As a result, a continuum description of the porous medium is introduced in which the field variable is defined as a convolution product of associated microscopic values with the exponential weighting function. An experimental method for measuring the field variable according to the convolution procedure is proposed. It is shown that in the field tests, the weighting function associated with the through-the-wall and mixing-cup measurement devices can be approximated by a 'table' function with the scale of support of the order of centimeters. it is postulated that tracer transport at the Twin Lake aquifer can be quantified with the local scale advection-dispersion equation, with dispersivity from field-tracer dispersion experiments found to be similar to those values obtained from 23 laboratory columns. The comparison between results of field and laboratory experiments showed that patterns of dispersion observed in field tests at the local scale (using different measurement devices with the same scale of support) are similar to the patterns observed in laboratory experiments. Comparison of the results showed the universal nature of the local scale aspects of the dispersion process. (Author's abstract)
W89-11270

BRINE DISCHARGE AND SALINIZATION, CONCHO RIVER WATERSHED, WEST TEXAS.
Texas Univ., Austin. Bureau of Economic Geology.
A. R. Dutton, B. C. Richter, and C. W. Kreitler.
Ground Water GRWAAR, Vol. 27, No. 3, p 375-383, May-June 1989. 12 fig, 1 tab, 21 ref. Railroad Commission of Texas Contract EAC(86-87)-1003.

Descriptors: *Geochemistry, *Water chemistry, *Water pollution effects, *Brines, *Groundwater pollution, *Water quality, *Water pollution sources, Saline-freshwater interfaces, Aquifers, Saline water, Brackish water, Hydraulic properties.

Discharge of naturally occurring brine from the Southern Great Plains regional groundwater flow system significantly affects water quality in local aquifers in the Concho River watershed in West Texas. The chemical variations in fresh groundwaters and subsurface brines in part of this watershed were investigated to develop diagnostic hydrochemical tools for identifying sources of saline groundwater into shallow aquifers. Aquifers in outcropping Permian rocks locally contain brine and hydrocarbons at depths as shallow as 135 ft (41 m). Maps of hydraulic head, salinity, and hydrochemical facies and graphs of ionic rations and stable isotopic composition locate where brackish to saline groundwater occurs naturally as a result of mixing between local recharge meteoric water and subsurface brine in the regional flow system. Br/Cl, Cl/SO4, Ca/Na, and delta D/delta O18 ratios distinguish between brine sources in the mixing zone. For example, chemical composition of brackish-to-saline shallow groundwaters beneath the Concho River watershed more closely resembles the composition of Permian than of Pennsylvanian formation brines. Other possible salinity sources include (1) seepage of salt water from rocks beneath oil field brine disposal pits, which ceased operation in the late 1960s, and (2) upward flow of artesian salt water across confining beds through decades-old abandoned oil-exploration holes. These sources are superimposed on the naturally occurring mixing zone between brine and fresh water. (Friedmann-PTT)
W89-11280

INFLUENCE OF MINERAL WEATHERING REACTIONS ON THE CHEMICAL COMPOSITION OF SOIL WATER, SPRINGS, AND GROUNDWATER, CATOCTIN MOUNTAINS, MARYLAND.
Geological Survey, Tallahassee, FL.
B. G. Katz.
Hydrological Processes HYPRE3, Vol. 3, No. 2, p 185-202, April/June 1989. 5 fig, 6 tab, 55 ref.

Descriptors: *Acid rain, *Water chemistry, *Weathering, *Erosion, *Acid rain, *Deicers, *Geochemistry, *Soil water, Water analysis, Groundwater, Calcium, Solute transport, Forest hydrology, Model studies, Hydrogen ion concentration.

During 1983 and 1984, wet precipitation was primarily a solution of dilute sulfuric acid, whereas calcium and bicarbonate were the major ions in springs and groundwater in two small watersheds with a deciduous forest cover in central Maryland. Dominant ions in soil water were calcium, magnesium, and sulfate. The relative importance of mineral weathering reactions on the chemical composition of these subsurface waters was compared to the contribution from wet precipitation, biological processes, and road deicing salts. Mineral reaction models, developed from geochemical mass-balance relationships, involved reactions of primary and secondary minerals in metabasalt and metarhyolite with hydrogen ion. Geochemical weathering reactions account for the majority of total ion equivalents in soil water (46 percent), springs (51 percent), and groundwater (68 to 77 percent). The net contribution of total ion equivalents from biological processes was 20 and 16 percent for soil water and springs, respectively, but less than 10 percent from groundwater. The contribution of total ion equivalents from deicing salts (10 to 20 percent) was related to proximity to roads. Strong acids in precipitation contributed 44 percent of the total amount of hydrogen ions involved in mineral-weathering reactions for groundwater in contact with metarhyolite compared to 25 percent for groundwater in contact with metabasalt, a rock type less resistant to weathering. (Author's abstract)
W89-11288

MECHANISM OF THE AEROBIC FE(III)-P SOLUBILIZATION AT THE SEDIMENT-WATER INTERFACE.
Lund Univ. (Sweden). Inst. of Limnology.
For primary bibliographic entry see Field 2H.
W89-11304

RADIUM ACCUMULATION FROM WATER BY FOILAGE OF THE WATER LILY, NYMPHAEA VIOLACEA.
Australian Nuclear Science and Technology Organisation, Sutherland. Environmental Science Div.
J. R. Twining.
Internationale Vereinigung fur Theoretische und Angewandte Limnologie, Verhandlungen IVTLAP, Vol. 23, No. 4, p 1954-1962, December 1988. 4 fig, 2 tab, 21 ref.

Descriptors: *Path of pollutants, *Bioindicators, *Bioaccumulation,erlilies, *Radium radioisotopes, Streams, Absorption, Uranium, Organicds, Regression analysis, Leaching, Adsorption.

The rates and extent of uptake and loss of radium by the foliage of Nymphaea violacea were assessed under laboratory conditions and parameters likely to influence radium-226 accumulation are identified. Radium-226 is a possible contaminant from the Ranger uranium mine at Jabiru, 240 km east of Darwin in the Northern Territory of Australia. The Magela Creek floodplain, 10 km downstream, supports large populations of N. violacea during the period of inundation from December to June. The plant is important because it is a traditional food of Aboriginal people and has a possible role in the biogeochemical cycling of radium. Simple linear regressions were performed to identify parameters controlling radium uptake. These results were supported by stepwise multiple regression analyses. Plant condition was the most significant influence on radium accumulation in the uptake phase. When condition was removed from the analysis, age became the predominant predictor. Leaf diameter was significant in the simple linear regression, but it was overshadowed by condition and age in the stepwise regressions. During the loss phase, time of exposure to clean water was the best predictor owing to the leaching of radium from the tissues. Stepwise linear regression of all parameters against radium activity in the second experiment confirmed that the condition of the leaves was the primary parameter controlling radium uptake. Achievement of equilibrium and the rapidity of uptake and loss indicate that the primary mechanism for accumulation of radium is surface adsorption or uptake by epiphytic communities, rather than metabolic uptake by Nymphaea. Radium is known to be strongly adsorbed on to organic ligands or to be associated with the organic fraction of sediments or soils or with the algal or microbial fraction in any system. The results of excised laminae experiments and the whole plant experiments showed conclusively that leaf condition was the main influence on the accumulation of radium. Condition controlled not only the extent of uptake while the plant was exposed to radium-contaminated water, but also the degree of radium retention during the loss phase. (Miller-PTT)
W89-11325

EXPERIMENTAL COMPARISON OF RADIUM-226 AND CALCIUM-45 KINETICS IN THE FRESHWATER MUSSEL, VELESUNIO ANGASI.
Australian Nuclear Science and Technology Organisation, Sutherland.
R. A. Jeffree.
Internationale Vereinigung fur Theoretische und Angewandte Limnologie, Verhandlungen IVTLAP, Vol. 23, No. 4, p 2193-2201, December 1988. 4 fig, 4 tab, 9 ref.

Descriptors: *Path of pollutants, *Mussels, *Radium radioisotopes, *Calcium, *Radioisotopes, Bioaccumulation.

An experimental investigation of the hypothesis that the biological half-life of 45Ca is shorter than that for 226Ra is described. The rates of accumulation and loss of 226Ra and 45Ca in the tissue of the freshwater mussel V. angasi were compared under experimental conditions. The biological half-lives for 45Ca in two compartments in the tissue (T(1)1/2 = 15 days, T(2)1/2 = 87 days) are much shorter than that for 226RA which is much greater than 167 days; this experimental result is in accordance with the increasing ratio of 226Ra to 45Ca tissue concentrations with age that has been observed in natural populations. The rate of accumulation of 226Ra per gram of tissue is proportional to the rate of 45Ca accumulation. The rate of accumulation of 226Ra and 45Ca per gram of tissue is inversely related to mussel shell breadth although these relationships are highly variable. Provision of cultures of Chlamydomonas algal cells as food for mussels during the experimental uptake phase did not significantly increase their accumulation of 226Ra, compared to mussels accumulating 226Ra directly from water alone, but significantly increased 45Ca accumulation. (Miller-PTT)
W89-11333

NITRATE, SULFATE AND HYDROGEN FLUXES THROUGH A BOREAL FOREST SNOWPACK DURING THE SPRING MELT PERIOD.
Institut National de la Recherche Scientifique, Sainte-Foy (Quebec).
H. G. Jones.
Internationale Vereinigung fur Theoretische und Angewandte Limnologie, Verhandlungen IVTLAP, Vol. 23, No. 4, p 2286-2290, December 1988. 2 fig, 1 tab, 10 ref.

Descriptors: *Fluctuations, *Acid rain, *Path of pollutants, *Snowmelt, *Snowpack, *Nitrates, *Sulfates, *Hydrogen ion concentration, Forests.

The results of mass balance study on both the snowpack and meltwaters in a coniferous forest ecosystem (LacLaflamme, Quebec) during the spring runoff of 1984 and 1985 are reviewed. Whether the relationship between H(+) and SO4(--) and NO3(-) in the snowpack is maintained during the production and discharge of meltwater to the snow-soil interface is determined. Results show that net changes in SO4(--) and/or NO3(-) were taking place in the pack with the appearance of free water. In addition the extent to which these strong acid anions contribute to the acidity of each hydrological compartment of the system was affected by the same phenomenon. For comparable summed concentrations of SO4(--) and NO3(-) the acidity is lower in the meltwater and in the wet pack than in the pack prior to melt. It is shown that biological depletion of NO3(-) and reduction of H(+) occur in wet snowpacks at a rate comparable to the physical processes of wet and dry deposition. The attenuation of the acidity of meltwaters by microbiological processes may be significant during the spring runoff when much of the annual load of acid pollution is discharged to northern boreal forest ecosystems. (Miller-PTT)
W89-11345

SOME ENVIRONMENTAL FACTORS AFFECTING SURVIVAL OF FECAL PATHOGENS AND INDICATOR ORGANISMS IN SEAWATER.
Alexandria Univ. (Egypt). Higher Inst. of Public Health.
F. El-Sharkawi, L. El-Attar, A. A. Gawad, and S. Molazem.
Water Science and Technology WSTED4, Vol. 21, No. 1, p 115-120, 1989. 2 fig, 4 tab, 7 ref.

Descriptors: *Fate of pollutants, *Bioindicators, *Pathogenic bacteria, *Seawater, Pathogens, Temperature effects, Salinity, Survival, Environmental effects, Coliforms.

The effects of certain environmental factors (temperature, salinity, and light) on the die-off of examples of fecal pathogens and indicator organisms in water (Salmonella typhii, Salmonella wein, Shigella flexineri, and Escherichia coli) were determined. The survival of these organisms was investigated in different types of water: (1) seawater, (2) filter sterilized seawater, (3) tapwater, and (4) normal saline. The organisms were counted every two hours for 8 hours, then daily for up to 7 days. It was found that there was no great difference in the survival times of the organisms tested at temperatures of 25-35 C; but at 40 C they died off more rapidly. The salinity of the seawater did not affect the survival time of the Salmonella bacteria. However, Sh. flexneri and E. coli appeared to survive longer in freshwater than in seawater at temperatures of 30-35 C. Daylight (sunlight) had a deleterious effect on all test organisms. Survival times were shorter when exposed to daylight than in the dark in the different types of water, being from several hours to 24 h compared to several days in the dark. Artificial light had less effect than natural daylight. It was concluded that exposure to sunlight is the most important factor in the self-purification of water polluted due to sewage outfalls. (Author's abstract)
W89-11358

EFFECT OF WATER TREATMENT ON THE LEVELS OF CHLORINATED ORGANICS AT DIFFERENT WATER STATIONS IN THE VICINITY OF ALEXANDRIA, EGYPT.
Alexandria Univ. (Egypt). Lab. of Environmental Chemistry and Toxicology.
A. H. El-Sebae, F. E. Macklad, A. S. El-Bakary, K. S. El-Gendy, and N. S. Ahmed.
Water Science and Technology WSTED4, Vol. 21, No. 1, p 131-135, 1989. 5 tab, 9 ref.

Descriptors: *Path of pollutants, *Water treatment, *Egypt, *Chlorinated hydrocarbons, *Hydrocarbons, Water pollution effects, Lindane, DDT, DDE, Coastal waters.

The effect of water treatment processes on the levels of chlorinated hydrocarbons (alpha-, beta-, gamma-HCH (lindane, DDE, and P,P'-DDT) and chlorophenols (2,4-D; 2,3-D; 2,3,4-T; 2,4,5-T; 2,3,4,6-tetro and pentochorophenol) collected from Bab-Shark and Abo-Hommos were analyzed by gas liquid chromatography. The results showed that water treatment steps did not significantly reduce or remove HCH from the treated water. This was shown by the high HCH content in the treated water when compared with the raw water. However, other compounds, like the DDE and P,P'-DDT, were undetected after water treatment. The data of chlorophenols content showed that 2,43-D was slightly reduced by water purification, while the other chlorinated phenolic compounds were increased. Generally, the levels of chlorinated hydrocarbons and chlorinated phenolic compounds were within the permissable levels in the drinking water, according to World Health Organization guidelines. (Author's abstract)
W89-11360

LEAD ACCUMULATION AND LOCATION IN THE SHOOTS OF THE AQUATIC LIVERWORT SCAPANIA UNDULATA (L) DUM. IN STREAM WATER AT GREENSIDE MINE, ENGLAND.
National Inst. for Environmental Studies, Ibaraki (Japan).
K. Satake, T. Takamatsu, M. Soma, K. Shibata, and M. Nishikawa.
Aquatic Botany AQBODS, Vol. 33, No. 1/2, p 111-122, March 1989. 4 fig, 2 tab, 25 ref.

Descriptors: *Bioaccumulation, *Aquatic life, *Path of pollutants, *Lead, *England, *Aquatic plants, Streams, Heavy metals, Liverworts, Sulfides, Sulfates.

Lead accumulation in the shoots of the aquatic liverwort Scapania undulata collected from a stream at an abandoned lead mine in England was studied with respect to its concentration, localization and chemical forms in the cells. The concentration of Pb in the stream water was 0.02 mg/l, and that of Pb in the shoots ranged from 0.7 to 2.4% Pb on a dry weight basis, giving an enrichment ratio of 350,000-1,200,000. Energy-dissipative X-ray microanalysis of the cells showed localization of Pb in the cell wall, while Pb was not detected in the nucleus and other components. A study of sulfur speciation in the shoot showed that sulfide-S, which would indicate the presence of PBS, was undetectable at a distinguishable concentration (<5 microg/g). An insoluble sulfate-S concentration of 78 microg/g, which may occur as PbSO4, was equivalent to about 3% of total Pb in the shoots of S. undulata. (Author's abstract)
W89-11368

CHEMICAL HYDROGEOLOGY IN NATURAL AND CONTAMINATED ENVIRONMENTS.
Geological Survey, Reston, VA.
For primary bibliographic entry see Field 2K.
W89-11372

PREDICTION OF SALT TRANSPORT DURING LEACHING OF SALINE SOILS FOR RECLAMATION.
Orissa Univ. of Agriculture and Technology, Bhubaneswar (India). Dept. of Soils and Agricultural Chemistry.
For primary bibliographic entry see Field 2K.
W89-11382

DETERGENTS AS A CONDITION OF POLLUTION FROM COASTAL MARINE AEROSOL.
Florence Univ. (Italy). Lab. of Technical Physical Chemistry.
For primary bibliographic entry see Field 5C.
W89-11383

HEAVY METALS IN SEDIMENTS OF THE INNER SHELF OF THE BEAUFORT SEA, NORTHERN ARCTIC ALASKA.
M. D. Sweeney, and A. Sathy-Naidu.
Marine Pollution Bulletin MPNBAZ, Vol. 20, No. 3, p 140-143, March 1989. 1 fig, 3 tab, 9 ref.

Descriptors: *Marine sediments, *Continental shelf, *Arctic, *Pollutant identification, *Heavy metals, *Alaska, Baseline studies, Statistical analysis, Sea ice.

Baseline data on sediment heavy metals available from four distinct geographic units along the inner shelf of the Beaufort Sea are presented. These are Harrison Bay, Simpson Lagoon-Gwydyr Bay, Stefansson Sound-Prudhoe Bay, and Beaufort Lagoon. The area encompassed extends about 430 km along the Beaufort Sea coast of Alaska. The remaining stations, located outside these four, relatively sheltered environments, were grouped separately under the title: Open Shelf. This group of stations extends seaward to the inner edge of the stamukhi zone, where grounded ice ridges protect the inner shelf from impingement by offshore pack ice. The mean, range, number of samples, standard deviation and percent coefficient of variation for each sediment variable are presented in each of the five geographic units. No reflection of the distinct weathering and depositional regimes in the Alaskan Arctic was identified in the heavy-metal abundances in the sediments. The abundances are not dissimilar to natural levels in corresponding carbonate and organic-poor sandy mud or muddy sand nearshore deposits from many tropical and temperate regions of the world. Analysis of the data from western Simpson Lagoon revealed that the proportion of silt and clay is the most important factor in the distribution of heavy-metal abundances. Nickel was found to be the best discriminator between different textural classes in Simpson Lagoon. (Author's abstract)
W89-11388

METALS IN OYSTERS FROM THE ARNHEM LAND COAST, NORTHERN TERRITORY, AUSTRALIA.
Darwin Inst. of Tech., Casuarina (Australia). Faculty of Applied Science.
N. Peerzada, and C. Dickinson.
Marine Pollution Bulletin MPNBAZ, Vol. 20, No. 3, p 144-145, March 1989. 1 fig, 1 tab, 9 ref.

Descriptors: *Path of pollutants, *Australia, *Heavy metals, *Oysters, Blacklip oyster, Milky oyster, Aquaculture, Shellfish farming, Baseline studies, Lead, Cadmium, Zinc, Copper, Nickel, Iron, Wildlife habitats, Wastewater disposal.

A preliminary survey of the Arnhem Land coast and some areas of Darwin Harbor was carried out to test for suitability of oyster culture location with respect to metal contamination. Two oysters occur in the Northern territory waters, the blacklip (Saccostrea echinata) and the milky oyster (Saccostrea cucullata). Of these, the blacklip is the larger, growing 15 cm shell width and is favored as an aquaculture prospect. No heavy metal data are available from Arnhem Land coast to establish natural background levels. Values for lead, zinc, copper, cadmium, nickel, and iron in the oysters from Arnhem Land coast and Port Darwin area are reported. The cadmium concentrations were extremely high in the oysters from Arnhem Land Coast and all exceeded the recommended NHMRC limit with Raragala Island being the highest (3.5 -18.0 microg/g). The Arnhem Land Coastal area of the Northern Territory is very sparsely populated, has no anthropogenic source of cadmium, is pollution-free and has virtually no industry with exception of Gove Harbor. The concentration of zinc in the oyster was highest (488-787 microg/g) at Rapid Creek. The concentration of zinc was also high at Gove Harbor (337-556 microg/g). Gove Harbor mainly received input from the bauxite industry operating at its shores. Elevated values of zinc are still within the recommended NHMRC limit of 1000 microg/g. The highest level of copper (45.2-70.2 microg/g) was found at East Point which is a wildlife reserve including Race Course Creek into which treated sewage is discharged, emptying into a base close to the sampling site. The oysters from Arnhem Land Coast were large but contained higher levels of cadmium and zinc with exception of the Coburg Peninsula which showed lower concentrations of zinc, copper and cadmium and may be considered as a suitable site for oyster culture. (Miller-PTT)
W89-11389

INFLUENCE OF AQUEOUS ALUMINIUM AND ORGANIC ACIDS ON MEASUREMENT OF ACID NEUTRALIZING CAPACITY IN SURFACE WATERS.
Corvallis Environmental Research Lab., OR.
T. J. Sullivan, C. T. Driscoll, S. A. Gherini, R. K. Munson, and R. B. Cook.
Nature (London) NATUAS, Vol. 338, No. 6214, p 408-410, March 1989. 4 fig, 1 tab, 27 ref.

Descriptors: *Water pollution effects, *Acid rain effects, *Acidic water, *Aluminum, *Neutralization, Surface water, Organic carbon, Acid rain, Fate of pollutants.

Acid neutralizing capacity (ANC) is used to quantify the acid-base status of surface waters. Acidic waters have been defined as having ANC values less than zero, and acidification is often quantified by decreases in ANC. Measured and calculated values of ANC generally agree, except for low-ANC waters. These waters, however, are of primary interest in lake-acidification studies. The discrepancy in ANC values is greatest for waters with high concentrations of aluminum and/or dissolved organic carbon (DOC). The discrepancy due to aluminum increases with increasing concentration of dissolved monomeric aluminum (Alm) and can exceed 50 microequivalents/liter at low pH and high Alm values. This error can be minimized by using a proton reference level for aqueous aluminum of 2+, rather than 0 or 3+, as is usually done. The value of 2+ is consistent with the mean charge on aluminum at the equivalence point of strong-acid titrations. The discrepancy between calculated and measured ANC also increases with increasing DOC concentrations, exceeding 50 microequivalents/liter for waters with DOC concentrations greater than 800 micromoles C/liter (1000 micromoles C/liter=12 mg/liter DOC). This error can be decreased by titrating to a low consistent pH value (for example, 3.0). This reduces the systematic underestimation of ANC due to curvature in Gran plot analysis, while still allowing accurate measurement of increments in hydrogen-ion concentration. ANC should not be used as a single parameter for characterizing the chemical suitability of surface waters for biota or for assessing the susceptibility of low-ANC waters to acidification by acid deposition. (Author's abstract)
W89-11401

IDENTIFICATION AND QUANTIFICATION OF P-CHLOROBENZENESULFONIC ACID IN GROUNDWATER.
National Enforcement Investigations Center, Denver, CO.
For primary bibliographic entry see Field 5A.
W89-11404

VANADYL IN NATURAL WATERS: ADSORPTION AND HYDROLYSIS PROMOTE OXYGENATION.
Eidgenoessische Anstalt fuer Wasserversorgung, Abwasserreinigung und Gewaesserschultz, Duebendorf (Switzerland).
B. Wehrli, and W. Stumm.
Geochimica et Cosmochimica Acta GCACAK, Vol. 53, No. 1, p 69-77, January 1989. 6 fig, 1 tab, 60 ref.

Descriptors: *Vanadium, *Path of pollutants, *Water chemistry, *Adsorption, *Hydrolysis, *Heavy metals, *Oxygenation, Chelating agents, Natural waters.

The aquatic chemistry of vanadium is dominated by V(IV) and V(V). Their species VO(++), VO(OH)(+) and H2VO4(-), respectively, occur primarily in natural waters. VO(++), as a very hard Lewis acid, has a strong tendency to coordinate with oxygen donor atoms and is thus capable of both forming strong complexes with soluble organic chelates and becoming specifically adsorbed to particles, especially hydrous oxides. Vanadates (V), like phosphates, also have a tendency to form, by ligand exchange, surface complexes with hydrous oxides. The V(IV)-V(V) couple is an interesting redox sensor because the redox transition occurs at Eh-values typically encountered at the sediment water interface; organic chelate formation may extend the redox boundary to Eh-values of about +0.4V (pH 7-8), but in the presence of dissolved oxygen vanadate (V) prevails. Experimental data on the adsorption of VO(++) and of V(V) (HV)4(-), VO2(+) on delta-Al2O3 and TiO2 (anatase) surfaces provide evidence for strong specific adsorption. The interaction of VO(++) with oxide surfaces is interpreted in terms of inner-sphere bidentate surface complexes with the surface central metal ions of the oxide VO(OM<)2 in heterogeneous systems. A comparison with published data on Mn(II) and Fe(II) oxidation shows that coordinated OH-groups of solid surfaces are able, like soluble hydroxo complexes, to mediate the electron transfer from the metal ions to the O2-molecule. (Author's abstract)
W89-11405

ATMOSPHERIC DEPOSITION OF BE7 AND BE10.
Carnegie Institution of Washington, DC. Dept. of Terrestrial Magnetism.
L. Brown, G. J. Stensland, J. Klein, and R. Middleton.
Geochimica et Cosmochimica Acta GCACAK, Vol. 53, No. 1, p 135-142, January 1989. 3 fig, 2 tab, 40 ref. DOE Grant DE-FG02-88ER-60635.

Descriptors: *Beryllium, *Isotope studies, *Dusts, *Chemistry of precipitation, *Path of pollutants, Rainfall, Illinois, Geochemistry, Isotopic tracers.

Measurements of beryllium (Be10) in precipitation taken in Hawaii, Illinois and New Jersey over a period of five years are reported. The contamination of rainwater with windblown soil presents a problem in the measurement of the atmospheric deposition of Be10. Rain collected at Mauna Loa, Hawaii has such low values of dust contamination that it has been taken as clean, and the data from Illinois and New Jersey are evaluated on that assumption. The deposition in a given amount of rain for the non-resuspended component is the same for all three stations, and it is proposed that the annual rate for mid-latitude locations having moderate rainfall is proportional to the local rainfall. Be7, which is probably negligibly contributed to the measurements by soil contamination, was measured for individual rains in Illinois and found to have a deposition of 14,000 atom/cu cm. The concentration variations between precipitation events greater than a factor of 20 exist for both isotopes and the relatively rare, high concentration events dominate deposition, thereby requiring long periods of observation to avoid significant error. Based on the present data and that of other researchers, it was concluded that the best value for Be10 deposition is 15,000 atom/cu cm, uncertain by 20%, and for Be7 is 12,000 atom/cu cm, uncertain by 25%. A global average deposition rate cannot be inferred directly for either isotope from these data; however, the theoretical global deposition rate for Be10 is shown to be consistent with the deposition reported here, if the concentration in equatorial rain is about 3,300 atom/g. (Author's abstract)
W89-11408

POLONIUM IN FLORIDA GROUNDWATER AND ITS POSSIBLE RELATIONSHIP TO THE SULFUR CYCLE AND BACTERIA.
Florida State Univ., Tallahassee. Dept. of Oceanography.
K. Harada, W. C. Burnett, P. A. LaRock, and J. B. Cowart.

Geochimica et Cosmochimica Acta GCACAK, Vol. 53, No. 1, p 143-150, January 1989. 7 fig, 2 tab, 39 ref, append. Florida Department of Environmental Regulation Contract No. FDER WM147 and FIPR 87-05-032.

Descriptors: *Geochemistry, *Water chemistry, *Polonium, *Sulfur, *Cycling nutrients, *Bacteria, *Groundwater pollution, *Florida, Uranium radioisotopes, Aquifers, Test wells, Bismuth, Path of pollutants, Radon, Lead.

The last radioactive member of the U238 natural decay-series, Po210 is normally considered a very particle-reactive isotope. Analysis of most natural waters shows that Po210 is present at very low activities, usually even lower than its insoluble precursor, Pb210. Recently it was shown that Po210 exists at very high concentrations in groundwater of some shallow aquifers in west central Florida. These waters tend to be fairly acidic (pH<5), sulfide-bearing, and relatively high in Rn222. Detailed study of one well with extraordinary levels of Po210 (approximately 1000 dpm/l) indicates that: (1) Po210 in this water is in great excess of radioactive equilibrium with its predecessors Pb210 and Bi210; (2) most Po in this water exists in a form which does not coprecipitate with an iron hydroxide scavenge; and (3) the conversion of soluble (0.2 micrometer filter) to particulate Po occurs over a time scale of a few days during sulfide oxidation. It is suspected that Po cycling in this environment is related to the sulfur cycle and may, therefore, be influenced by sulfur bacteria. (Author's abstract)
W89-11409

NUTRIENT LOAD CARRIED BY THE RIVER PO INTO THE ADRIATIC SEA, 1968-87.

Milan Univ. (Italy). Ist. di Biologia.
R. Marchetti, A. Provini, and G. Crosa.
Marine Pollution Bulletin MPNBAZ, Vol. 20, No. 4, p 168-172, April 1989. 5 fig, 33 ref.

Descriptors: *Eutrophication, *Po River, *Orthophosphates, *Phosphorus, *Nitrates, *Ammonia, *Adriatic Sea, *Path of pollutants, Nutrients, Industrial wastes, Farm wastes, Fertilizers.

Analytical data for orthophosphate phosphorus, nitrates and ammonia were collected from 1968-1987 at the closure section of the River Po basin and were analyzed for the increase in the load of nutrient load carried into the Adriatic Sea. The load of orthophosphate phosphorus increased from 200 tons/yr in the years 1968-1970 to 5,000 tons/yr in 1980 and the total mineral nitrogen (nitrate plus ammonia) from 50,000 tons/yr to 100,000 tons/yr in the same period. The well developed industries along the Po and the extensive agriculture and animal husbandry activities of the basin are the cause of the high nutrient loading. Phosphorus levels were no different before or after 1985, the year in which the use of phosphorus-containing detergents was banned. These increased loads of nutrients have been blamed for a decrease in transparency in the north Adriatic Sea. Other causes for the increased load of nutrients are the increased cultural use of phosphorus and nitrogen; the entry on the market of water softeners containing phosphorus; and the extension of the sewer systems collecting municipal and industrial discharges, with secondary treatment plants only. (Geiger-PTT)
W89-11417

HIGH RESOLUTION SEDIMENTARY RECORDS OF HEAVY METALS FROM THE SANTA MONICA AND SAN PEDRO BASINS, CALIFORNIA.

Oregon State Univ., Corvallis. Coll. of Oceanography.
B. Finney, and C. Huh.
Marine Pollution Bulletin MPNBAZ, Vol. 20, No. 4, p 181-187, April 1989. 5 fig, 2 tab, 31 ref. DOE Grant DE-FG05-85ER60340.

Descriptors: *Water pollution sources, *Heavy metals, *Sedimentology, *California, *Wastewater treatment, Lead, Zinc, Chromium, Iron, Cobalt, Aluminum, Barium, Marine sediments, Trace elements, Organic carbon.

Box cores collected from the Santa Monica and San Pedro Basins during 1986 and 1987 were analyzed for organic carbon, Pb210 and more than 20 major and minor elements. Downcore variations in the profiles of Pb, Zn, and Cr largely reflect anthropogenic inputs, whereas profiles of Fe and Co are strongly modified by diagenesis in near-surface sediments. Both of these factors appear to influence the downcore distribution of Cu. The cores show pronounced subsurface maximum in Pb, Zn, and Cr which, based on Pb210 dating, correspond to about 1970. Of the most likely anthropogenic sources of these metals, the time-series of emissions from the JWPCP wastewater treatment plant is most in accord with the sedimentary records. The high correlation between organic carbon and Pb, Zn, and Cr in the cores is consistent with the presence of particulate matter of sewage origin. Thus post-1970 improvements in wastewater treatment are reflected in the near-surface decreases in heavy metals. (Author's abstract)
W89-11420

METALS IN NORTHEAST PACIFIC COASTAL SEDIMENTS AND FISH, SHRIMP, AND PRAWN TISSUES.

Environmental Protection Service, West Vancouver (British Columbia). Pacific and Yukon Region.
L. Harding, and D. Goyette.
Marine Pollution Bulletin MPNBAZ, Vol. 20, No. 4, p 187-189, April 1989. 1 fig, 2 tab, 3 ref.

Descriptors: *Baseline studies, *British Columbia, *Benthos, *Cadmium, *Lead, *Mercury, *Trace metals, *Bioaccumulation, Fate of pollutants, Marine sediments, Fish, Shrimp, Biological magnification.

Trace metals in sediment and tissues of epibenthos were analyzed in samples taken from along the British Columbia coast (Hecate Strait, Surf Inlet, Laredo Sound, Quatsino Sound, and Barkley Sound). In sediments, trace metals Cd, Cr, Cu, and Hg were significantly correlated with Al, representing the clay fraction. Lowest metal levels were found in Hecate Strait. Metal levels were similar among the coastal inlet stations except that Laredo Sound had higher Hg levels, and Quatsino Sound surface sediments had elevated Cu, evidently tailings from a mine in Rupert Inlet, at the head of the Sound. Metal levels in some shrimp and prawn catches were statistically different between areas, although the differences were not great. Slight bioconcentration (tissue metal levels greater than sediment metal levels) was observed in fish for both Cd and Hg. Cd tended to concentrate more in liver tissue, while Hg concentrates more in muscle (bioconcentration factors <1-14). (Geiger-PTT)
W89-11421

CONCENTRATIONS OF DICHLORVOS IN BEIRTREACH BUI BAY, IRELAND.

Trinity Coll., Dublin (Ireland). Dept. of Zoology.
O. Tully, and D. Morrissey.
Marine Pollution Bulletin MPNBAZ, Vol. 20, No. 4, p 190-191, April 1989. 1 fig, 5 ref.

Descriptors: *Pesticides, *Dichlorvos, *Organophosphorus pesticides, *Ireland, *Marine sediments, *Seawater, *Path of pollutants, Daphnia, Crustaceans, Bays, Gas chromatography, Water pollution effects.

Seawater and sediment samples were taken from Beirtreach Bui Bay in the west of Ireland to determine levels of the organophosphate pesticide dichlorvos. The survey was carried out in September 1988 after a summer period of use of the pesticide and between 36 and 84 hr after one particular application of 8 liters of Nuvan at site 3. In total, 6 liters of Nuvan were used at that site between April and September 1988. Water samples were taken at 5 m or 10 m depth at each station at low and high tide on 8 September, at mid-tide on 9 September and at low tide on 10 September. At high tide on 9 September samples were taken at 5 m intervals from the surface to 25 m at one station. Sediment samples (mud to an approximate depth of 15 cm) were taken on 9 September by SCUBA or van Veen grab (9 samples). Levels of Dichlorvos were determined by gas chromatography. The lower detection limit was 0.02 micrograms/liter. All but one extract had concentrations less than this. To quantify any trace amounts of dichlorvos in the extracts, one water and one sediment extract were chosen randomly and concentrated to 1 ml. After reanalysis these were found to contain approximately 0.001 micrograms/liter dichlorvos. An exception to these results was an extract from a water sample taken at 25 m on 9 September and it contained 0.13 micrograms/liter which is in the lethal range reported for freshwater crustaceans Daphnia pulex and Simnocephalus serratus. These results indicate that only trace levels of dichlorvos were present in seawater and sediments after a summer period of Nuvan application and 36-84 hr after the release of 8 liters of Nuvan from one point. These low concentrations indicate that dichlorvos dissipated rapidly after release and there was no cumulative increase in dichlorvos levels throughout the study area as a result of its use on fish farms over an extended period. (Geiger-PTT)
W89-11422

SIMULATION MODEL FOR THE FATE OF PESTICIDE RESIDUES IN A FIELD SOIL.

Central Agricultural Pesticides Lab., Cairo (Egypt).
Z. Shaaban, and A. M. Elprince.
Plant and Soil PLSOA2, Vol. 114, No. 2, p 187-195, February 1989. 5 fig, 2 tab, 22 ref.

Descriptors: *Fate of pollutants, *DDT, *Groundwater pollution, *Pesticide kinetics, *Lindane, *Toxaphenes, Degradation, Model studies, Leachates, Adsorption, Mathematical studies, Sensitivity analysis.

A model simulating the fate of pesticides in soil was developed from the one dimensional convective-dispersive-reaction equation. The model assumed a constant pore-water velocity (v), linear-equilibrium adsorption, and first-order degradation. The adsorption parameter (kd) was calculated from molecular structure with the help of a first-order molecular connectivity index. On the basis of the results of sensitivity analysis the model was made partially stochastic in order to account for horizontal heterogeneity in a field soil. Concentration profiles were obtained by employing the mode, median and mean values of (v, D) while the values of Kd and t1/2 were kept constants; where D and t1/2 were the apparent diffusion coefficient and the degradation half-life, respectively. The resulting extremes in concentration profiles were expected to be observed within a relatively small area of the heterogeneous field soil. A random variable, namely the contaminated depth was defined so that the soil beneath it would be practically free of pesticides during its entire life-time. The values of contaminated depth (1, 2, and 3) under continuous leaching were (0.14, 0.56, 1.00 m), (0.29, 1.50, 2.62 m), and (0.65, 2.25, 4.00 m) for DDT, toxaphene and lindane, respectively; where contaminated depth 1, 2, and 3 were values calculated by employing the mode, median, and mean values of (v, D), respectively. Within a relatively small area the first value would be frequently observed whereas the others would be less pronounced. The depth and shape of the resultant base of the contaminated zone were substantially more sensitive to changes in the surface rates of recharge than to changes in the values of the chemical parameters kd and t1/2. These results suggest that during the entire lifetimes of the pesticides in the Nile soils of Egypt, the quality of groundwaters would not be affected by DDT, little affected by toxaphene, and possibly seriously affected by lindane in a field soil with a groundwater table at a depth of 1.5 m. (Author's abstract)
W89-11423

NON-LINEAR RESPONSE OF WET DEPOSITION TO EMISSIONS REDUCTION: A MODEL STUDY.

Ontario Ministry of the Environment, Rexdale.
For primary bibliographic entry see Field 5G.
W89-11452

ESTIMATES OF REGIONAL CONTRIBUTIONS TO WET ACID DEPOSITION IN WESTERN MASSACHUSETTS DURING THE SUMMER OF 1984.
General Motors Research Labs., Warren, MI. Environmental Science Dept.
G. T. Wolff.
Atmospheric Environment ATENBP, Vol. 23, No. 3, p 595-601, March 1989. 1 fig, 7 tab, 27 ref.

Descriptors: *Air pollution sources, *Water pollution sources, *Acid rain, *Precipitation, *Chemistry of precipitation, *Massachusetts, Sulfates, Sulfur dioxide, Nitrates, Tracers, Northeast, Midwest.

The General Motors mobile Atmospheric Research Laboratory was situated in rural western Massachusetts in the Berkshire Mountains for 62 days during the summer of 1984. One purpose of this study was to determine the source regions of wet acid deposition for this northeastern U.S. location. First, to apportion the precursors (sulfate, sulfur dioxide and nitrate) to source regions, daily ambient air samples were analyzed for the precursors as well as for tracer species that are associated with particular sources. Factor and trajectory analyses were then used to deduce the contributions of the Midwest and the Northeast to these precursors. Finally, the contribution of the precursors to precipitation acidity was estimated by analyzing the chemical constituents in the rain during seven precipitation events. Averaged over the entire duration of the study, the data show that Northeast sources accounted for about 60% of the precipitation sulfate and nitrate, while Midwest sources accounted for about 30%. The balance (about 10%) was accounted for by background sulfate. A more useful way of examining the data is according to the type of storm that caused the wet deposition. The site was affected by two basic types of storms: coastal low-pressure systems that traveled up the Atlantic Coast, and cold fronts that approached from the west. During the coastal low-pressure events, the Midwestern contribution to precipitation acidity was zero, as easterly flows from the Atlantic Ocean dominated. However, the cold front events were all associated with southwesterly flows, and the Midwest contributions exceeded the Northeast contributions. During these events, the average Midwest contribution to precipitation acidity was about 50%. For all events, the ratio of sulfate to nitrate was approximately 2:1 on an equivalent basis. It was estimated that particulate sulfate scavenging was responsible for about half of the sulfate in the rain, while the other half was due to in-cloud oxidation of gaseous sulfur dioxide. (Author's abstract)
W89-11453

IODINE-129 IN THE SNAKE RIVER PLAIN AQUIFER AT THE IDAHO NATIONAL ENGINEERING LABORATORY, IDAHO.
Geological Survey, Idaho Falls, ID. Water Resources Div.
L. J. Mann, E. W. Chew, J. S. Morton, and R. B. Randolph.
Available from Books and Open File Report Section, USGS, Box 25425, Denver, CO 80225; paper copy $4.75, microfiche $4.00. USGS Water-Resources Investigations Report 88-4165, Sept. 1988. 27p, 6 fig, 2 tab, 30 ref.

Descriptors: *Groundwater pollution, *Iodine radioisotopes, *Wastewater disposal, *Radioactive wastes, *Water quality, *Idaho, Groundwater recharge, Idaho National Engineering Laboratory.

From 1953 to 1983, an estimated 0.01 to 0.136 Ci (curies)/year of iodine-129 were contained in wastewater generated by the ICPP (Idaho Chemical Processing Plant) at the !daho National Engineering Laboratory. The wastewater was directly discharged to the Snake River Plain aquifer through a deep disposal well until February 9, 1984, when the well was replaced by an unlined infiltration pond; a second pond was put into use on October 17, 1985. For 1984-86, the annual amount of iodine-129 in wastewater discharged to the ponds ranged from 0.0064 to 0.039 Ci. In August 1986, iodine-129 concentrations in water from 35 wells near the ICPP ranged from less than the reporting level to 3.6 +or-0.4 pCi/L (picocuries/L). By comparison, in April 1977 the water from 20 wells contained a maximum of 27 +or-1 pCi/L of iodine-129; in 1981, the maximum concentration in water from 32 wells was 41 +or-2 pCi/L. The average concentrations of iodine-129 in water from 18 wells that were sampled in 1977, 1981 and 1986 were 4.0, 6.7 and 1.3 pCi/L, respectively. The marked decrease in the iodine-129 concentration from 1981 to 1986 is the result of three factors: (1) The amount of iodine-129 disposed annually; (2) a change from the routine use of the disposal well to the infiltration ponds; and (3) a dilution of the iodine-129 in the aquifer by recharge from the Big Lost River. (USGS)
W89-11477

HYPOLIMNETIC CONCENTRATIONS OF DISSOLVED OXYGEN, NUTRIENTS, AND TRACE ELEMENTS IN COEUR D'ALENE LAKE IDAHO.
Geological Survey, Boise, ID. Water Resources Div.
P. F. Woods.
Available from Books and Open File Report Section, USGS, Box 25425, Denver, CO 80225; paper copy $9.25, microfiche $4.00. USGS Water-Resources Investigations Report 89-4032, 1989. 56p, 3 fig, 14 tab, 15 ref.

Descriptors: *Zinc, *Dissolved oxygen, *Eutrophication, *Trace elements, *Limnology, *Idaho, *Coeur d'Alene Lake, Toxicity, Nutrients, Water quality, Transparency.

A reconnaissance study of Coeur d'Alene Lake, Idaho done from May through November 1987 assessed water quality throughout the lake. Particular emphasis was on hypolimnetic concentrations of dissolved oxygen, nutrients, and trace elements. Study results enabled refinement of the sampling protocol in a U.S. Geological Survey research proposal for a large-scale investigation of nutrient enrichment and trace element contamination problems affecting the 129.5 sq kilometer lake in northern Idaho. Hypolimnetic dissolved-oxygen concentrations as low as 4.1 mg/L in November and the frequent occurrence of supersaturated dissolved-oxygen concentrations during June through August indicated nutrient enrichment. Secchi-disc depths in the lake's central and southern areas were typical of mesotrophic conditions, whereas oligotrophic conditions prevailed in the northern area. Throughout the study, hypolimnetic concentrations of total recoverable zinc exceeded chronic and acute toxicity criteria for freshwater aquatic life. (USGS)
W89-11478

HYDROLOGIC CONDITIONS AT THE IDAHO NATIONAL ENGINEERING LABORATORY, 1982 TO 1985.
Geological Survey, Idaho Falls, ID. Water Resources Div.
J. R. Pittman, R. G. Jensen, and P. R. Fischer.
Available from Books and Open File Report Section, USGS, Box 25425, Denver, CO 80225; paper copy $12.00, microfiche $4.00. USGS Water-Resources Investigations Report 89-4008, Dec. 1988. 73p, 35 fig, 6 tab, 35 ref.

Descriptors: *Radioactive wastes, *Groundwater pollution, *Radioactive waste disposal, *Tritium, *Perched groundwater, *Idaho, *Groundwater movement, *Water quality, Idaho National Engineering Laboratory.

Aqueous chemical and radioactive wastes discharged since 1952 to unlined ponds and wells at the INEL (Idaho National Engineering Laboratory) have affected water quality in perched groundwater zones and in the Snake River Plain Aquifer. Routine waste water disposal was changed from deep injection wells to ponds at the ICPP (Idaho Chemical Processing Plant) in 1984. During 1982-85, tritium concentrations increased in perched groundwater zones under disposal ponds, but cobalt-60 concentrations decreased. In 1985, perched groundwater under TRA disposal ponds contained up to 1,770 +or-30 pCi/mL (picocuries/milliliter) of tritium and 0.36+or-0.05 pCi/mL of cobalt-60. During 1982-85, tritium concentrations in water in the Snake River Plain aquifer decreased as much as 80 pCi/mL near the ICPP. In 1985, measurable tritium concentrations ranged from 0.9+or-0.3 to 93.4+or-2.0 pCi/mL. Tritium was detected in groundwater near the southern boundary of the INEL, 9 miles south of the ICPP and TRA. Strontium-90 concentrations in groundwater, up to 63 +or-5 pCi/L (picocuries per liter) near the ICPP, generally were smaller than 1981 concentrations. Cesium-137 concentrations in groundwater near the ICPP ranged from 125 +or-14 to 237 +or-45 pCi/L. Maximum concentrations of plutonium-238 and plutonium-239, -240 (undivided) were 1.31 +or-.0019 pCi/ml and 1.9 +or-0.00003 pCi/L. Sodium and chloride generally decreased during 1982-85. Nitrate concentrations increased near the TRA and NRF (Naval Reactors Facility) and decreased near the ICPP. (USGS)
W89-11482

GENETIC TYPING IN A CLUSTER OF LEGIONELLA PNEUMOPHILA INFECTIONS.
Amsterdam Univ. (Netherlands). Dept. of Medical Microbiology.
R. J. van Ketel, and B. de Wever.
Journal of Clinical Microbiology JCMIDW, Vol. 27, No. 5, p 1105-1107, May 1989. 1 fig, 1 tab, 30 ref.

Descriptors: *Legionella, *Infection, *Epidemiology, Bacteria, Pathogenic bacteria, Air conditioning, Cooling towers, Drinking water, Enzymes, Water pollution sources, Diseases, Human diseases, Isolation.

Legionella pneumophila strains isolated from six patients, three air-conditioning-derived and cooling tower-derived strains, and three hot water supply-derived strains were analyzed by three genetic typing methods. The results of the whole-cell DNA restriction endonuclease analysis and the restriction patterns based on genes coding for RNA correlated with each other and demonstrated that the patient isolates were indistinguishable from the air-conditioning-derived and cooling tower-derived isolates but differed markedly from the hot water supply-derived isolates. The patient and air-conditioning-derived and cooling tower-derived strains contained plasmids of the same molecular weight; the hot water supply-derived strains were plasmidless. These results indicate that the cooling tower or the air-conditioning system was the environmental source for the examined cluster of Legionnaires disease strains. (Author's abstract)
W89-11503

THERMAL AND WATER SOURCE EFFECTS UPON THE STABILITY OF ENTEROVIRUSES IN SURFACE FRESHWATERS.
Environmental Protection Agency, Cincinnati, OH.
C. J. Hurst, W. H. Benton, and K. A. McClellan.
Canadian Journal of Microbiology CJMIAZ, Vol. 35, No. 4, p 474-480, April 1989. 7 tab, 11 ref.

Descriptors: *Enteroviruses, *Survival, *Temperature effects, *Path of pollutants, *Fate of pollutants, Aquatic environment, Viruses, Lakes, Artificial lakes, Rivers, Ponds, Groundwater, Water temperature, Mortality, Incubation, Bacteria, Conductivity, Hardness, Turbidity, Physical properties, Chemical properties, Suspended solids.

The long-term survival of three human enterovirus serotypes, Coxsackievirus B3, echovirus 7, and poliovirus 1, was examined in samples of surface freshwater collected from five sites of physically different character. These were an artificial lake created by damming a creek, a small groundwater outlet pond, both a large-sized and medium-sized river, and a small suburban creek. Efforts were made to determine whether the rate of viral inactivation observed at the different incubation temperatures was related to characteristics inherent to the water that was collected from the different locations. The characteristics examined included physical and chemical parameters, indigenous bacterial counts, and the amount of bacterial growth that the waters would support (measured as the

maximum number of generations which seeded bacteria could undergo after being placed into either pasteurized or sterile-filtered water samples). Analysis of viral inactivation rate versus these characteristics revealed three apparent effectors of viral persistence. These were (1) hardness and conductivity, both of which strongly correlated with one another; (2) turbidity and suspended solids content, both of which strongly correlated with one another; and (3) the number of generations of bacterial growth that a sample was capable of supporting, which also correlated with hardness and conductivity. (Doria-PTT)
W89-11506

ENVIRONMENTAL SIGNIFICANCE OF THE POTENTIAL FOR MER(TN21)-MEDIATED REDUCTION OF HG(2+) TO HG(0) IN NATURAL WATERS.
Environmental Protection Agency, Gulf Breeze, FL. Gulf Breeze Environmental Research Lab.
T. Barkay, C. Liebert, and M. Gillman.
Applied and Environmental Microbiology AEMIDF, Vol. 55, No. 5, p 1196-1202, May 1989. 1 fig, 3 tab, 43 ref.

Descriptors: *Mercury, *Bacterial physiology, *Biotransformation, Adaptation, Microbiological studies, Heavy metals, Fate of pollutants, Physiological ecology.

The role of mer(Tn21) in the adaptation of aquatic microbial communities to Hg(2+) was investigated using a DNA probe. Elemental mercury was the sole product of Hg(2+) volatilization by freshwater and saline water microbial communities. Bacterial activity was responsible for biotransformation because most microeucaryotes did not survive the exposure conditions, and removal of larger microbes (> 1 micron) from adapted communities did not significantly ($P > 0.01$) reduce Hg(2+) volatilization rates. DNA sequences homologous to mer(Tn21) were found in 50% of Hg(2+)-resistant bacterial strains representing two freshwater communities, but in only 12% of strains representing two saline communities (the difference was highly significant; $P < 0.001$). Thus, mer(Tn21) played a significant role in Hg(2+) resistance among strains isolated from fresh waters, in which microbial activity had a limited role in Hg(2+) volatilization. In saline water environments in which microbially mediated volatilization was the major mechanism of Hg(2+) loss, other bacterial genes coded for this biotransformation. (Author's abstract)
W89-11508

MICROZONATION OF DENITRIFICATION ACTIVITY IN STREAM SEDIMENTS AS STUDIED WITH A COMBINED OXYGEN AND NITROUS OXIDE MICROSENSOR.
Aarhus Univ. (Denmark). Inst. of Ecology and Genetics.
For primary bibliographic entry see Field 2H.
W89-11511

EFFECTS OF SURFACE WETNESS ON THE EVOLUTION AND VERTICAL TRANSPORT OF SUBMICRON PARTICLES.
Argonne National Lab., IL. Biological, Environmental, and Medical Research Div.
I. Y. Lee, and M. L. Wesely.
Journal of Applied Meteorology JAMOAX, Vol. 28, No. 3, p 176-184, 1989. 7 fig, 3 tab, 27 ref.

Descriptors: *Air pollution, *Vertical flow, *Acid rain, *Path of pollutants, *Sulfates, *Particulate matter, *Air-earth interfaces, *Air circulation, Turbulent flow, Eddies, Model studies, Moisture, Simulation, Microenvironment, Wetting, Particle size.

Simulations have been carried out with a numerical model describing air chemistry, aerosol microphysics, and turbulent mixing, in order to study the behavior of fine sulfate particles in the atmospheric surface layer over wet surfaces. Achievement of local equilibrium of sulfuric acid vapor between the gas phase and particles is rapid and can overpower turbulent mixing in controlling local particle size distributions. Numerical results clearly indicate that in regions of relative humidities lower than about 80 percent, the large submicron particles increase in number at the expense of concentrations of smaller particles. Simulations that incorporate turbulent mixing and surface dry deposition above wet surfaces show rapid change of vertical flux with height and tend to produce downward fluxes for particles larger than 0.1 microns in radius and upward fluxes for particles smaller than about 0.05 microns in radius. This tendency has been seen in fluxes measured by eddy correlation at heights of several meters above surfaces of varying wetness. However, the model has not reproduced certain other observations, such as strong upward fluxes of the larger particles above the sea and persistence of upward fluxes of the smaller particles above coniferous forests for several hours after surface wetness disappears. In addition, the numerical indications that fluxes of the smaller particles tend to change direction within a meter of a wet surface have yet to be supported by field experiments. (Author's abstract)
W89-11539

RELATIONSHIP BETWEEN PARTICULATE CHEMISTRY AND AIR MASSES IN SOUTHERN INDIANA,
Purdue Univ., Lafayette, IN. Dept. of Agronomy.
R. H. Grant, and W. W. McFee.
Journal of Applied Meteorology JAMOAX, Vol. 28, No. 3, p 185-193, 1989. 8 fig, 4 tab, 23 ref.

Descriptors: *Atmospheric chemistry, *Acid rain, *Air masses, *Particulate matter, *Indiana, *Atmosphere, Air pollution, Sulfate, Sodium, Chlorides.

The particulate characteristics of the surface layer of the atmosphere over a region of southwest Indiana were determined for 42 24-hr periods between September 1985 and April 1986. The water-soluble sulfate, chloride and sodium content of particles classified into mass median diameters (MMD) of 7, 3.3, 2, 1.1 microns and less than 1.1 micron, were related to different air masses. Atmospheric concentrations of chloride and sodium and the S/Cl and Na/Cl ratios in particles with MMD greater than or equal to 3.3 microns were used to differentiate between maritime and continental air masses. Maritime, compared to continental, air masses had higher concentrations of sulfate in all particle sizes. Both synoptic situations had high concentrations of sulfate-bearing particles with MMD < 1.1 microns and to a lesser degree with MMD 7 microns. It is concluded that the MMD > 3.3 microns particle chloride and sodium were primarily due to sea-salt particles and that the MMD < 1.1 microns and some of the MMD 7 microns sulfate particles in greater concentrations in the maritime air mass air were probably largely due to anthropogenic sources to the south of Indiana. (Author's abstract)
W89-11540

LAKE RESTORATION BY REDUCING EXTERNAL PHOSPHORUS LOADING: THE INFLUENCE OF SEDIMENT PHOSPHORUS RELEASE.
North East River Purification Board, Stirling (Scotland).
For primary bibliographic entry see Field 5G.
W89-11543

CHANGES IN NA, K, CA, MG AND AL CONTENT OF SUBMERSED LEAF LITTER, RELATED TO INGESTION BY THE AMPHIPOD GAMMARUS PULEX (L).
Royal Holloway and Bedford New Coll., Egham (England). Dept. of Biology.
For primary bibliographic entry see Field 2H.
W89-11545

CHANGES IN DIATOM-INFERRED PH AND ACID NEUTRALIZING CAPACITY IN A DILUTE, HIGH ELEVATION, SIERRA NEVADA LAKE SINCE A.D. 1825.
California Univ., Santa Barbara. Dept. of Biological Sciences.
R. W. Holmes, M. C. Whiting, and J. L. Stoddard.
Freshwater Biology FWBLAB, Vol. 21, No. 2, p 295-310, April 1989. 5 fig, 5 tab, 65 ref. California Air Resources Board Contracts A3-096-32 and A4-118-32.

Descriptors: *Mountain lakes, *Acid rain effects, *Hydrogen ion concentration, *Bioindicators, *Diatoms, *Lake sediments, *Neutralization, Lakes, Ecosystems, Mathematical equations, Aquatic environment, Species composition, California, Radioactive dating, Lead radioisotopes, Porosity, Sedimentation rates.

Equations have been developed that describe relationships between the relative abundance of diatom assemblages in the surface sediments of twenty-seven Sierra Nevada lakes and the present pH and acid neutralizing capacity in these lakes. These equations were used to reconstruct pH and acid neutralizing capacity at twenty-four depth intervals in a 20 cm-long sediment core from Emerald Lake, a dilute, high elevation lake, located in Sequoia National Park, California. Lead 210 data, sediment porosity, and accumulation rates of total dry weight were obtained. The lead 210 dates, obtained at intervals in one sediment core, provided an estimate of the sediment accumulation rate in the lake. The estimated date of the 19-20 cm sediment level was A.D. 1825. Thus, the average sediment accumulation rate was calculated to be 1 mm/year. The equations for estimating pH and acid neutralizing capacity (ANC) overestimate the pH of the uppermost 0.5 cm of sediment (as measured by present-day pH of Emerald Lake) and presumably, the pH at greater depths in the core. The diatom-inferred pH and acid neutralizing capacity values indicated that neither pH nor acid neutralizing capacity exhibited significant trends since about A.D. 1825. It is concluded from the diatom analysis that Emerald Lake has not been affected by acidic deposition. (Friedmann-PTT)
W89-11552

PREDICTING OIL INFILTRATION AND REDISTRIBUTION IN UNSATURATED SOILS.
Battelle Memorial Inst., Richland, WA. Pacific Northwest Labs.
J. W. Cary, C. S. Simmons, and J. F. McBride.
Soil Science Society of America Journal SSSJD4, Vol. 53, No. 2, p 335-342, March/April 1989. 4 fig, 3 tab, 15 ref, 3 append.

Descriptors: *Oil pollution, *Soilwater, *Path of pollutants, *Soil contamination, *Infiltration, *Loam, *Hydrocarbons, *Oil spills, Oil, Soil water, Aeration zone, Plumes, Soil columns.

The infiltration and redistribution of two viscous hydrocarbon oils, with viscosities 4.7 and 77 times greater than water, were observed in columns of moist silt loam and loamy sand soils. The time required for water and oil to infiltrate the two soils and the final volumetric liquid contents after 8 h were measured. These observations are compared to the results predicted by a simple multiphase flow code base on scaling oil flow to unsaturated soil water flow by using classical capillary theory and relative viscosities. A new function for describing the oil permeability was derived and, when used in the code, produced oil content distributions with depth that agreed reasonably well with those observed. The actual oil infiltration time was generally less than predicted, however. The flow of the two organic liquids into moist soils was found to be predictable, based only on classical soil-water relations and the organic liquids' physical properties, under the imposed experimental conditions. (Author's abstract)
W89-11578

RADIATION EFFECTS ON CHEMISTRY.
Battelle Pacific Northwest Labs., Richland, WA.
For primary bibliographic entry see Field 5E.
W89-11590

SUBSURFACE TRANSPORT IN WATER AND GAS.
Disposal Safety, Inc., Washington, DC.

B. Ross, and S. Amter.
Engineering Geology EGGOAO, Vol. 26, No. 4, p 373-403, April 1989. 2 fig, 122 ref.

Descriptors: *Underground waste disposal, *Radioactive waste disposal, *Landfills, *Path of pollutants, *Geologic control, *Geochemistry, Model studies, Flow system, Density, Saturated flow, Solute transport, Geologic fractures, Colloids, Variability, Simulation analysis, Surface-groundwater relations, Groundwater barriers.

Current designs for nuclear-waste repositories rely primarily upon subsurface geologic barriers for long-term containment. Because water and air are generally considered to be the mechanisms most likely to transport radioactivity to the surface environment, flow and transport models are important tools in repository assessment. Most models assume that the geologic medium can be treated as a continuum. A substantial body of recent work has focussed on applying these models to difficult-to-solve problems, such as the simulation of variably dense or variably saturated flow and transport, large and complex flow systems, sharp solute concentration fronts, and fractured rock systems. The complex chemical interactions between the transport fluid and solid particles within the system have been analyzed using geochemical flow models, most of which assume that the system is at chemical equilibrium. The role of colloids in contaminant transport is a relatively new area of research. The large-scale effects of small-scale variability within the geologic system have been the subject of intense investigation. Inherent limitations of the continuum approach have prompted the design of models in which the flow occurs in discrete fractures. The difficulty and complexity of simulating transport has led to the development of network transport models, which represent the flow field as a series of one-dimensional path segments. The widespread use of models for prediction and analysis has prompted investigations of their reliability and relative merits. (Author's abstract)
W89-11591

NATURAL ANALOGUES.
Disposal Safety, Inc., Washington, DC.
For primary bibliographic entry see Field 5E.
W89-11592

SORPTION OF 2,3,7,8-TETRACHLORODIBENZO-P-DIOXIN FROM WATER BY SURFACE SOILS.
Maryland Univ., College Park. Dept. of Civil Engineering.
R. W. Walters, S. A. Ostazeski, and A. Guiseppe-Elie.
Environmental Science and Technology ESTHAG, Vol. 23, No. 4, p 480-484, April 1989. 3 fig, 2 tab, 15 ref. U.S. Environmental Protection Agency assistance agreements CR-811743-01-0 and CR-813601-01-0 to the University of Maryland.

Descriptors: *Pellicular water, *Chlorinated hydrocarbons, *Soil absorption capacity, *Surface-groundwater relations, *Path of pollutants, Organic carbon, Isotherms, Sorption, Soil analysis, Suspension, Methanol, Times Beach, Carbon radioisotopes.

The sorption of C14-labelled 2,3,7,8-tetrachlorodibenzo-p-dioxin (TCDD) from water by two uncontaminated surface soils from the Times Beach, Missouri, area was evaluated by using batch shake testing. Sorption isotherm plots for the soil with the lower fraction organic carbon (f-OC) were linear, and regression analysis was used to determine a value of the sorption coefficient (K-D) of 30,400 milliliters per gram. This value corresponds to a value of log K-OC of 6.66, where K-OC is the partition coefficient normalized on the basis of soil organic carbon content. Significant interferences attributed to the presence of nonseparable suspended particles (NSP) were apparent in the measurement of the water-phase concentrations of TCDD for experiments involving the high-f-OC soil. Prewashing this soil from one to five consecutive times with water appeared to reduce these interferences, as individual-point distribution ratios approached the K-OC value determined for the low-f-OC soil. The measured value of log K-OC agrees with the reported estimate of log K-OC of 6.6 for TCDD made by applying the cosolvent theory to isotherm data generated with water/methanol mixtures. (Author's abstract)
W89-11594

BACKGROUND TRENDS OF PH OF PRECIPITATION OVER INDIA.
Meteorological Office, Poona (India).
For primary bibliographic entry see Field 2B.
W89-11610

LONG-TERM EFFECTS OF POLLUTANTS ON PH OF RAIN WATER IN NORTH INDIA.
Indian Inst. of Tropical Meteorology, Poona.
L. T. Khemani, G. A. Momin, P. S. Prakasa Rao, P. D. Safai, and G. Singh.
Atmospheric Environment ATENBP, Vol. 23, No. 4, p 753-756, April 1989. 2 tab, 20 ref.

Descriptors: *Air pollution effects, *Hydrogen ion concentration, *Acid rain, *India, Developing countries, Chlorides, Sulfates, Nitrates, Ammonia, Sodium, Potassium, Calcium, Agra, Delhi, Industrial development, Chemistry of precipitation, Industrial development.

The ionic composition and pH of rainwater samples collected during the summer monsoon seasons of 1963 and 1965 at Agra and Delhi, respectively, have been compared with those of samples collected during the summer monsoon seasons of 1984 at both cities. The samples were analyzed for Cl(-), SO4(2-), NO3(-), NH4(+), Na(+), K(+), and Ca(2+). The pH values at Agra and Delhi decreased by 2.8 (9.1-6.3) and 0.9 (7.0-6.1) units, respectively, after two decades. During this time the cities developed industrially to a great extent. The main cause for the decrease in the pH values is a significant increase of acidic components and decrease of soil-oriented components in the rain water. For the first time in India, long-term effect of pollutants on the pH of rain water have been observed but the effects are comparatively slow compared with those in western countries. The growth of industry in India is very slow and, therefore, the anthropogenic pollutants have still not overpowered the natural pollutants released from soil and sea. (Author's abstract)
W89-11611

SPREAD OF ACID RAIN OVER INDIA.
Indian Inst. of Tropical Meteorology, Poona.
L. T. Khemani, G. A. Momin, P. S. Praksa Rao, P. D. Safai, and G. Singh.
Atmospheric Environment ATENBP, Vol. 23, No. 4, p 757-762, April 1989. 2 fig, 1 tab, 37 ref.

Descriptors: *Air pollution effects, *Acid rain, *India, *Industrial development, Hydrogen ion concentration, Calcium, Sulfates, Anions, Cations, Alkaline soils, Aerosols, Urban areas, Rural areas.

Rain water and aerosol samples were collected at a few locations representative of urban and non-urban regions in India. Rain water samples were also collected in and around a coal-fired power plant. All the rain water and aerosol samples were analyzed for major chemical components along with pH. The rain water at all the places of measurement, except near the industrial sources, has been found to be alkaline and was characterized by the presence of excess cations, particularly by Ca(2+). The acid rain near the industrial sources was associated with excess anions, especially SO4(2-). The atmospheric aerosols at all the places of measurement were found rich with basic components, suggesting that the alkaline soil dust and fly ash are responsible at present for preventing the spread of acid rain in India. (Author's abstract)
W89-11612

MEASUREMENTS OF ELEMENTAL COMPOSITION OF AEROSOL MATTER AND PRECIPITATION FROM A REMOTE BACKGROUND SITE IN INDIA.
Bhabha Atomic Research Centre, Bombay (India). Pollution Monitoring Section.
T. N. Mahadevan, B. S. Negi, and V. Meenakshy.
Atmospheric Environment ATENBP, Vol. 23, No. 4, p 869-874, April 1989. 1 fig, 6 tab, 20 ref.

Descriptors: *Chemistry of precipitation, *Air pollution, *India, *Aerosols, Particulate matter, Lead, Potassium, Zinc, Bromine, Antimony, Sulfur, Iron, Chemical composition, Baseline studies, Rural areas.

Aerosol measurements were made from a remote continental site (Mallikadevi) 100 km from Nainital in Northern India during November 1982 to May 1983. The average total suspended particulate matter concentration was around 20 microg/cu m, the lowest recorded in comparison with the generally higher levels observed in the Indian subcontinent. Of the 18 elements measured, the concentration levels of Pb, K, Zn, and Br show marginal enrichments relative to their crustal abundances using Fe as the reference element. Factor analysis indicates specific source patterns more closely related to biomass combustion and a complex mixture of components derived from natural and pollution sources. The wet deposition chemistry indicates the importance of calcerous soil derived materials and sea salt elements with marginal enrichment for Zn, Sb, S, K, and Br. The presence of anthropogenic elements at very low levels, comparable to data reported from other rural sites, indicates that Malikadevi can be considered as a background site from the Indian subcontinent. (Author's abstract)
W89-11613

SUBSURFACE TRANSPORT OF CONTAMINANTS.
Oak Ridge National Lab., TN.
J. F. McCarthy, and J. M. Zachara.
Environmental Science and Technology ESTHAG, Vol. 23, No. 5, p 496-502, May 1989. 4 fig, 43 ref. Dept. of Energy Contract DE-AC05-840R21400, Pacific Northwest Lab. Contract DE-AC06-76RL0 1830.

Descriptors: *Solute transport, *Path of pollutants, *Groundwater pollution, *Subsurface drainage, *Colloids, Contamination, Distribution patterns, Adsorption.

Contaminants originating from human activities have entered the subsurface environment through waste disposal practices, spills, and land application of chemicals. Contaminants that are sparingly soluble in water and that have a strong tendency to bind to aquifer media are assumed to move more slowly than the rate at which groundwater flows. Therefore, current approaches to monitoring and predicting contaminant transport generally ignore colloid-facilitated transport mechanisms. Whether a particle will be stable, aggregated, filtered, or will settle in groundwater depends on a complex combination of density, size, the surface chemistry, the water chemistry, and the water flow rates. Empirically, the colloid interaction can be factored into a distribution coefficient (K sub d) between the mobile and immobile phase, thus decreasing the retardation factor. This approach is appropriate for many hydrophobic contaminants that exhibit linear partitioning and the absence of competitive sorption with other like solutes. However, a constant K sub d approach is not appropriate for most inorganic solutes because their sorption is nonlinear. Therefore, calculations of colloid-facilitated transport are hampered by an inability to predict physicochemical dynamics of colloids in the groundwater zone. The manipulation of colloid mobilization and deposition could be a useful tool for the mitigation or remediation of waste sites. Removing highly adsorbed contaminants from groundwater could be enhanced by the controlled mobilization, collection, and treatment of colloids from the affected groundwater zone. (White-Reimer-PTT)
W89-11616

RELATIONSHIP BETWEEN SUBSURFACE BIODEGRADATION RATES AND MICROBIAL DENSITY.
Virginia Polytechnic Inst., Blacksburg. Dept. of

Civil Engineering.
G. T. Hickman, and J. T. Novak.
Environmental Science and Technology ESTHAG, Vol. 23, No. 5, p 525-532, May 1989. 6 fig, 4 tab, 44 ref.

Descriptors: *Fate of pollutants, *Water pollution treatment, *Biodegradation, *Soil contamination, *Microbial degradation, Methanol, Phenols, Butyl alcohol, Correlation coefficient, Regression analysis, Soil chemistry.

Rates and patterns of biodegradation of methanol, phenol, and tert-butyl alcohol (TBA) in surface and subsurface soils were evaluated in static microcosms. Biodegradation rates in subsurface soils generally were within the ranges 0.5-1.1 mg/L/d for methanol, 0.4-1.1 mg/L/d for phenol, and 0.1-0.3 mg/L/d for TBA (linear approximation normalized by soil dry weight; initial concentration, 100 mg/L; incubation temperature, 20 C). Microbial density was measured in soils by plate counting (aerobic and anaerobic), by substrate-specific MPN analysis, and by direct microscopical counting. Linear regression was employed to determine if biodegradation rates were correlated to microbial measures of the soils. The two types of data were directly related, but correlation coefficients were generally low. Coefficients of determination indicated that, at best, 87%, 92%, and 37% of the variability in subsurface biodegradation rates of methanol, phenol, and TBA, respectively, could be attributed to differences in the measures of bacterial density. The reasons for the lack of high correlation between rates and microbial density in subsurface soils are not clear. It may be that microbial measuring techniques currently available are not sensitive or accurate enough to distinguish the differences in biodegradation rates observed in subsurface soils. (Author's abstract)
W89-11617

EVIDENCE OF ATMOSPHERIC TRANSPORT AND DEPOSITION OF ORGANOCHLORINE PESTICIDES AND POLYCHLORINATED BIPHENYLS IN CANADIAN ARCTIC SNOW.
Environmental Protection Service, Regina (Saskatchewan). Water Quality Branch.
D. J. Gregor, and W. D. Gummer.
Environmental Science and Technology ESTHAG, Vol. 23, No. 5, p 561-565, May 1989. 1 fig, 3 tab, 18 ref.

Descriptors: *Arctic, *Path of pollutants, *Snow, *Air pollution, *Organochlorine pesticides, *Polychlorinated biphenyls, Pesticides, Hexachlorocyclohexanes, Dieldrin, Endosulfan, Chlordane, Heptachlor, Air masses, Canada, Lindane.

Snowpack samples representing snow accumulation for the winter of 1985/1986 were collected at a total of 12 sites widely distributed throughout the Northwest Territories, Canada, during the spring of 1986. All samples were collected as large-volume snow samples and were sealed into Teflon bags within boxes. The snow was melted at room temperature and extracted in field laboratories for analyses of organochlorine pesticides (OCs) and total PCBs. Hexachlorocyclohexanes (HCHs), consisting of the pesticide lindane (0.20-4.08 ng/L) and the isomer alpha-HCH (0.43-8.72 ng/L) usually made up more than 75% of the total OCs measured. These were followed in Abundance by alpha-endosulfan and dieldrin (generally ranging between 0.5 and 1.0 ng/L) and alpha-chlordane and lambda-chlordane and heptachlor at concentrations less than 0.5 ng/L. PCB concentrations ranged from 0.02 to 1.76 ng/L with most of the samples having concentrations less than 1.0 ng/L. The only reasonable source for these compounds is long-range atmospheric transport to the Canadian Arctic and subsequent wet and dry deposition. Differences among stations are attributed to the influx of essentially localized, clean snow and a reduced influence of polluted air masses during the winter season in the more southerly stations. (Author's abstract)
W89-11620

BIOAVAILABILITY AND TOXICOKINETICS OF POLYCYCLIC AROMATIC HYDROCARBONS SORBED TO SEDIMENTS FOR THE AMPHIPOD PONTOPOREIA HOYI.
National Oceanic and Atmospheric Administration, Ann Arbor, MI. Great Lakes Environmental Research Lab.
P. F. Landrum.
Environmental Science and Technology ESTHAG, Vol. 23, No. 5, p 588-595, May 1989. 6 fig, 4 tab, 33 ref.

Descriptors: *Path of pollutants, *Hydrocarbons, *Amphipods, *Sediments, *Bioaccumulation, Interstitial water, Sediment-water interfaces, Bioavailability, Absorption, Desorption, Conceptual models, Ingestion.

The accumulation kinetics, by the benthic amphipod, Pontoporeia hoyi, were measured for sediment-associated, selected polycyclic aromatic hydrocarbons (PAHs) and 2,4,5,2',4',5',-hexachlorobiphenyl (HCB). The kinetics data suggest that uptake occurs largely via the sediment interstitial water and is kinetically controlled by desorption from sediment particles and dissolved organic matter. Assimilation from ingested material may be significant for the more strongly sorbed compounds such as benzo(a)-pyrene and HCB. The desorption rate of contaminants from the sediment matrix appears to determine whether the major sediment contaminant source is interstitial water or ingested particles. The log of the contaminant uptake clearance is inversely proportional to the log octanol-water partition coefficient for PAHs. Bioavailability of sediment-sorbed contaminants declined as the contact time between the sediment and contaminant increased. Chemical extractability remained high even though bioavailability was reduced. A conceptual model was developed to obtain a qualitative description of the complex data and to use as a basis for experimental designs. The age of sediments ingested by different benthic organisms may be quite different; for instance, oligochaetes ingest sediment several centimeters below the surface while P. hoyi feed at the surface. Thus, the amount of bioavailable compound may well be different for the different organisms, even with equal chemically extractable concentrations. (Author's abstract)
W89-11622

COASTAL SEQUENCES, EASTERN BUZZARDS BAY, MASSACHUSETTS: NEGLIGIBLE RECORD OF AN OIL SPILL.
Georgia Univ., Athens. Dept. of Geology.
R. W. Frey, J. D. Howard, and J. Dorjes.
Geological Society of America Bulletin BUGMAF, Vol. 101, No. 5, p 461-465, May 1989. 6 fig, 22 ref.

Descriptors: *Sedimentology, *Fate of pollutants, *Oil spills, *Massachusetts, *Coasts, Cores, Sediments, Buzzards Bay, Environmental effects, Rehabilitation, Physiology, Biochemistry.

In September, 1969, a barge ran aground and spilled approximately 600 t of Number 2 fuel oil into eastern Buzzards Bay. The oil spread over more than 400 ha of bay floor and eventually was incorporated within bottom sediments to water depths of more than 10 m. Oil also accumulated along approximately 6.5 km of coastline. A study of the eastern bay was begun in early summer of 1975, nearly 6 yr after the original spill, yet well before the expected dissipation of its final chemical effects. The studies included benthic invertebrates as well as physical and biogenic sedimentary structures and encompassed 208 cores from 14 sites. Examinations of cores included relief peels, stereo X-ray radiographs, and complete dissection of core remnants. Although bottom sediments had been affected throughout the area, no discontinuity surfaces among beach, shoreface, or offshore cores that could be attributed directly to sediment contamination and reactivation were found. Instead, the sedimentary record indicated normal deposition within a typical beach-to-offshore energy. Virtually all sediments had been reworked, whether by physical or biological processes. Although some macroscopic disruptions noted in Wild Harbor and Old Silver marshes must have been related to the oil spill, their sedimentary record differed little from that of equivalent sites in normal dynamic equilibrium with fluctuating intertidal conditions. The greatest lingering effects apparently were recorded not in sedimentary sequences or physical and biogenic sedimentary structures but, rather, at the level of molecular physiology and sedimentary biochemistry. (White-Reimer-PTT)
W89-11637

DISSOLVED OXYGEN DYNAMICS IN THE MID-PASSAIC RIVER: MATHEMATICAL MODEL.
Cook Coll., New Brunswick, NJ. Dept. of Environmental Science.
B. Stahl, and C. G. Uchrin.
Journal of Environmental Science and Health (A) JESEDU, Vol. 24A, No. 2, p 175-193, February 1989. 10 fig, 3 tab, 9 ref.

Descriptors: *Rivers, *Path of pollutants, *Water pollution effects, *Model studies, *Dissolved oxygen, *Water quality, *Mathematical models, *New Jersey, *Passaic River, *Biochemical oxygen demand, Oxygen balance, Oxygen depletion, Fourier series, Photosynthesis, Algae, Calibrations, Nitrogen, Carbon, Oxygen deficit.

A systematic methodology for mathematically simulating photosynthetically driven dissolved oxygen (DO) is presented. A water quality model was constructed for the Passaic River between Two Bridges and Little Falls, New Jersey. A steady-state model for BOD-DO dynamics was calibrated and verified to data from two stream surveys conducted during the summer and fall of 1983. Diurnal DO fluctuations due to algal photosynthetic activity were simulated by Fourier series. Calibration of the steady-state DO-BOD model was accomplished in three steps. First, the nitrogen BOD model was calibrated; then the carbon BOD model; and finally the DO deficit model using the rate coefficients obtained in the first two steps. The models displayed good correlation to the data. (White-Reimer-PTT)
W89-11642

ADSORPTION OF ALUMINIUM BY STREAM PARTICULATES.
Freshwater Biological Association, Ambleside (England).
E. Tipping, M. Ohnstad, and C. Woof.
Environmental Pollution ENPOEK, Vol. 57, No. 2, p 85-96, 1989. 3 fig, 2 tab, 16 ref.

Descriptors: *Acid rain effects, *Path of pollutants, *Adsorption, *Particulate matter, *Aluminum, *Stream pollution, Mathematical equations, Suspended load, Mathematical studies, England, Humic substances, Chemical properties, Hydrogen ion concentration.

An experimental study was made of the adsorption of aluminium by fine particulates from Whitray Beck, a hill stream in northwest England. Adsorption increased with Al(3+) activity, pH and concentration of particles, and could be quantitatively described by an empirical equation in which concentrations, activities, and three constants, expressed as mol/l, g particles/l, and 1.472, are factors. For the experimental data, the equation gave a correlation ratio of 0.99. The equation accounts reasonably well for the adsorption of Al by particulates from seven other streams. In applying the equation, it must be borne in mind that the desorption kinetics of Al depend on pH, and rapid reversibility (< 15 min) can only be assumed for pH < or = 5.5. Calculations using the adsorption equation, and taking competition by dissolved humic substances into account, suggest that adsorbed Al may commonly account for a significant proportion (> or = 10 percent) of total monomeric Al. (Author's abstract)
W89-11646

DISTRIBUTION OF PLANKTONIC BACTERIA CAPABLE OF DEGRADING SODIUM DODECYL SULPHATE (SDS) IN A POLLUTED SOUTH WALES RIVER.
University Coll., Cardiff (Wales). Dept. of Bio-

chemistry.
G. F. White, D. J. Anderson, and M. J. Day.
Environmental Pollution ENPOEK, Vol. 57, No. 2, p 103-115, 1989. 4 tab, 22 ref.

Descriptors: *Aquatic bacteria, *Detergents, *Surfactants, *Wales, *Biodegradation, *Fate of pollutants, *Population density, *Sulfates, *Plankton, *Stream pollution, Temporal distribution, Degradation, Stream biota, Estuaries, Sodium compounds, Enzymes, Distribution patterns.

The temporal and geographical distributions of planktonic bacteria, and their ability to degrade sodium dodecyl sulfate (SDS) (AS+ phenotype), in a polluted South Wales river, is reported for five sites from source to estuary sampled during a one-yr period. The annual mean prevalence of AS+ isolates at all sites was 8.1-16.0 percent of total number of isolates, and these values were not altered by including SDS in culture media. Although the proportion of AS+ isolates in clean water at the source was not significantly different from that of polluted sites, the AS+ cell density was lower at the source because of its lower overall numbers. The percentage of AS+ isolates in estuarine water was higher than at the three polluted mid-river sites, but when cell numbers were taken into account, the AS+ cell density was the same at all polluted sites including the estuary. There was no correlation between percentage of AS+ and either BOD or oxygen concentration, but AS+ isolates were significantly more prevalent at the end of summer. Of the AS+ isolates, more than half contained constitutive alkylsulfatase enzymes, the remainder being induced or repressed by SDS; the relative proportions of enzyme regulatory type did not vary significantly between sites or at different sampling times. (Author's abstract)
W89-11647

ORGANO-TINS IN SEDIMENTS AND MUSSELS FROM THE SADO ESTUARINE SYSTEM (PORTUGAL).

Bordeaux-1 Univ., Talence (France). Groupe d'Oceanographie Physicochimique.
P. Quevauviller, R. Lavigne, R. Pinel, and M. Astruc.
Environmental Pollution ENPOEK, Vol. 57, No. 2, p 149-166, 1989. 4 fig, 4 tab, 34 ref.

Descriptors: *Pollutant identification, *Organotins, *Marine sediments, *Mytilus, *Estuaries, *Portugal, *Bottom sediments, *Pesticides, Water pollution sources, Bioaccumulation, Population exposure, Pollution load, Mussels, Coastal waters, Mollusks, Degradation products.

Analyses of methyl-tin and butyl-tin levels in freshwater, estuarine and marine sediments from the Sado estuarine system, and in mussels (Mytilus galloprovincialis) from its adjacent coast, have been performed in order to detect the contaminated areas. The main inputs of tributyl-tin (TBT), along with degradation products dibutyl-tin and monobutyl-tin (DTB and MBT), were detected in the estuarine zone, due to high discharge from shipyards located in this area. These levels are sometimes very high, ranging from 235 to 12,200 ng/g total butyl-tins in sediments. Such inputs lead to higher bioconcentration values in mussels in the estuarine zone, as well as in a harbor located along the adjacent coast. The bioconcentration of organo-tins in mussel tissues could be enhanced in estuarine turbid waters, due to an ingestion of butyl-tins adsorbed onto fine particles, in comparison with non-turbid coastal waters. Debutylation processes occur in both sediments and mussel tissues; in organisms, these processes may lead to the formation of inorganic tin, which may be methylated differently according to the period of the year. (Author's abstract)
W89-11650

METAL CONTAMINATION OF DRINKING WATER FROM CORROSION OF DISTRIBUTION PIPES.

University of Petroleum and Minerals, Dhahran (Saudi Arabia). Water Resources and Environment Div.
I. A. Alam, and M. Sadiq.
Environmental Pollution ENPOEK, Vol. 57, No. 2, p 167-178, 1989. 4 fig, 2 tab, 22 ref.

Descriptors: *Contamination, *Corrosion, *Water distribution, *Water pollution sources, *Drinking water, *Heavy metals, *Pipes, Water quality standards, Water pollution, Potable water, Pipelines, Conveyance structures, Public health, Saudi Arabia, Copper, Iron, Zinc, Water transport, Path of pollutants.

Metal contamination of drinking water resulting from the corrosion of distribution pipes, and its significance on human health, were evaluated. A community in Dhahran, Saudi Arabia, which is served from its own desalination facilities, was chosen for the study. About 150 drinking water samples were collected and analyzed for metal concentrations using an inductively coupled argon plasma analyzer. It was found that copper, iron and zinc in the drinking water increased during its transportation from the desalination plant to the consumers. This increase was related to the length and material of distribution pipes. Concentrations of copper and zinc were increased during overnight storage of water in the appliances. All water samples for iron, calcium, magnesium, and zinc were below the highest desirable or highest permissible safe drinking water levels as established by the World Health Organization (WHO); many samples showed levels of iron that exceeded the desirable, but were below the maximum permissible limits; all zinc levels were far below the highest desirable levels. High sodium levels were found in samples, attributable to the groundwater used for blending, chlorination with sodium hypochlorite, and the pH adjustment process that used soda ash. The levels of many other tested heavy metals, including lead, chromium, cadmium, and aluminum, were below detection limits. The results of this study indicate that corrosion of the distribution pipes and appliances could contaminate drinking water. (Friedmann-PTT)
W89-11651

INTERSPECIFIC DIFFERENCES IN ZN, CD, AND PB ACCUMULATION BY FRESHWATER ALGAE AND BRYOPHYTES.

Durham Univ. (England). Dept. of Botany.
M. G. Kelly, and B. A. Whitton.
Hydrobiologia HYDRB8, Vol. 175, No. 1, p 1-11, April 29 1989. 3 fig, 7 tab, 27 ref. EEC Contracts 074-74-1 and DGR/480/571.

Descriptors: *Bioaccumulation, *Path of pollutants, *Heavy metals, *Algae, *Mosses, *Zinc, *Cadmium, *Mosses, *Lead, Aquatic plants, Sublethal effects, Stream biota, Statistical analysis, Bioindicators.

The relationships between the concentrations of zinc, cadmium and lead in aquatic plants and the concentrations of these metals in the ambient water have been compared for three algae (Lemanea fluviatilis, Cladophora glomerata, Stigeoclonium tenue), one liverwort (Scapania undulata) and three mosses (Amblystegium riparium, Fontinalis antipyretica, Rhynchostegium riparioides). The data to establish these relationships are all based on earlier studies. They come from a wide range of stream sand rivers in Belgium, France, Germany, Ireland, Italy and the U.K. There were significant bivariate positive relationships between concentrations of Zn, Cd and Pb in water and plant for all species except Cd and Pb in Stigeoclonium tenue. When relationships were compared using datasets with total or filtrable metals in water, most differences were slight. However, there were marked differences both between species and between metals. Comparison for the seven species of Zn in the plant when aqueous Zn is 0.01 mg/l, a concentration at which all seven were found, shows that the four bryophytes had the highest concentrations; however, the two green algae had steeper slopes (representing change in concentration in plant in response to change in aqueous concentration). Lemanea fluviatilis had a slope closer to that of the bryophytes, but the concentration was about one order of magnitude lower. All seven species were found at a concentration of 0.01 mg/l Pb, and at this concentration there were almost two orders of magnitude difference between the species that accumulated the most (Scapania undulata) and the one that accumulated the least (Cladophora glomerata). The steepest slope was shown, however, by C. glomerata. All the species studied here are among the ten recommended for analysis when monitoring heavy metal pollution in U.K. waters. It is shown that Rhynchostegium riparioides and Scapania undulata are likely to be the species most useful for monitoring purposes under steady state conditions of pollution by Zn, Cd and Pb. (Friedmann-PTT)
W89-11652

BIOTRANSFORMATION OF MERCURY BY BACTERIA ISOLATED FROM A RIVER COLLECTING CINNABAR MINE WATERS.

Siena Univ. (Italy). Dipt. di Biologia Ambientale.
F. Baldi, M. Filippelli, and G. J. Olson.
Microbial Ecology MCBEBU, Vol. 17, No. 3, p 263-274, 1989. 3 fig, 4 tab, 42 ref.

Descriptors: *Mine wastes, *Mine drainage, *Stream pollution, *Path of pollutants, *Biotransformation, *Mercury, *Aerobic bacteria, Biochemistry, Biodegradation, Bacteria, Degradation, Heavy metals, Trace elements, Organic compounds, Pollutants, Metabolism, Italy, Detoxification.

One hundred six strains of aerobic bacteria were isolated from the Fiora River which drains an area of cinnabar deposits in southern Tuscany, Italy. Thirty-seven of the strains grew on an agar medium containing 10 micrograms/ml Hg (as HgCl2) with all of these strains producing elemental mercury. Seven of the 37 strains also degraded methylmercury. None of 106 sensitive and resistant strains produced detectable monomethylmercury, although 15 strains produced a benzene-soluble mercury species. Two strains of alkylmercury (methyl, ethyl and phenylmercury) degrading bacteria were tested for the ability to degrade several other analogous organometals and organic compounds, but no activity was detected toward these compounds. Mercury methylation is not a mechanism of Hg resistance in aerobic bacteria from this environment. Growth of bacteria on the agar medium containing 10 micrograms/ml HgCl2 was diagnostic for Hg detoxification based on reduction. (Author's abstract)
W89-11665

HYDROLOGY AND WATER QUALITY ASPECTS OF RHINE BANK GROUNDWATER IN THE NETHERLANDS.

Keuringsinstituut voor Waterleidingartikelen, Rijswijk (Netherlands).
For primary bibliographic entry see Field 2F.
W89-11683

KINETICS OF THE UPTAKE OF 14C-LABELED CHLORINATED BENZENES FROM SOIL BY PLANTS.

Gesellschaft fuer Strahlen- und Umweltforschung m.b.H. Muenchen, Neuherberg (Germany, F.R.). Inst. fuer Oekologische Chemie.
E. Topp, I. Scheunert, and F. Korte.
Ecotoxicology and Environmental Safety EESADV, Vol. 17, No. 2, p 157-166, April 1989. 7 tab, 16 ref.

Descriptors: *Soil-water-plant relationships, *Path of pollutants, *Bioaccumulation, *Chlorinated benzenes, *Radioactive tracers, *Soil contamination, Barley, Cress, Lysimeters.

(14C)Benzene, (14C)1,2,4-trichlorobenzene, (14C)pentachlorobenzene, and (14C)hexachlorobenzene were applied to soils in outdoor lysimeters to a 10-cm depth (2mg/kg dry soil); barley and cress plants were grown for one vegetation period and analyzed after varying time intervals. The bioaccumulation factors (concentration of radioactive substances in plants divided by that in soils) of barley were higher than those of cress, except for hexachlorobenzene. In barley, bioaccumulation factors increased with decreasing chlorine content of the molecules, except for benzene, whereas in cress hexachlorobenzene exhibit-

ed the highest bioaccumulation factor. The conversion ratios of chlorinated benzenes (percentage of conversion products based on total radioactivity in plants) were negatively correlated to the chlorine content of the molecules and, in barley, positively correlated with time. In general, they were higher in barley than in cress. The concentration of radioactive substances in the plants, as well as bioaccumulation factors, decreases with time, except for a slight increase in benzene-derived residues in barley after 125 days. This effect is due to growth dilution. The percentage of radioactivity in barley seeds, based on that in the whole plant, was negatively correlated to the chlorine content of the molecule. (Author's abstract)
W89-11729

REVIEW OF THE SCHISTOSOMIASIS RISK IN SOUTH AFRICAN DAMS,
Research Inst. for Diseases in a Tropical Environment, Nelspruit (South Africa).
For primary bibliographic entry see Field 6G.
W89-11749

SOLUTE TRANSPORT IN POROUS MEDIA WITH SOLID-LIQUID MASS TRANSFER LIMITATIONS: APPLICATION TO ION EXCHANGE.
SEPAREX, Champigneulles (France).
R. M. Nicoud, and D. Schweich.
Water Resources Research WRERAO, Vol. 25, No. 6, p 1071-1082, June 1989. 4 fig, 2 tab, 39 ref, 2 append.

Descriptors: *Fluid-solid interactions, *Solute transport, *Path of pollutants, *Ion exchange, Model studies, Kinetics, Mass transfer, Diffusion, Hydrologic models, Trace levels, Mathematical models.

Pollutant transport is governed by three main mechanisms: (1) water flow, (2) thermodynamic equilibrium constraints between the solid and the liquid phases, and (3) chemical kinetics and mass transfer kinetics between the phases or different compartments within a given phase. Basic principles are presented for modeling nonlinear fluid-solid interactions controlled by mass transfer. Assuming that exchange equilibrium can be described by mass action laws, it is shown here how to properly model the kinetic process with external and internal diffusion limitations using average concentrations and characteristic diffusion times. These characteristic diffusion times are defined as those used to describe linear interactions, whereas the overall process is nonlinear due to the equilibrium constraints. The characteristic times are expressed in terms of the diffusion coefficients, characteristic dimensions of the exchanging aggregates, and relevant parameters of the flow regime. These expressions allow one to extrapolate laboratory measurements to field-scale systems. The internal diffusion time is shown to be related to the selectivity factor. The analysis shows that external diffusion prevails in most situations, and especially at trace levels. A new criterion incorporating the nonlinear equilibrium law is proposed to determine whether the rate-limiting step is internal or external diffusion. (Rochester-PTT)
W89-11751

ATMOSPHERIC SULFUR DEPOSITION 1950-1985 INFERRED FROM SULFATE IN GROUNDWATER.
Waterloo Univ. (Ontario). Inst. for Ground Water Research.
W. D. Robertson, J. A. Cherry, and S. L. Schiff.
Water Resources Research WRERAO, Vol. 25, No. 6, p 1111-1123, June 1989. 6 fig, 3 tab, 35 ref.

Descriptors: *Ontario, *Acid rain, *Groundwater pollution, *Sulfates, *Water pollution sources, Tritium, Radioactive tracers, Dating, Evapotranspiration, Sudbury, Smelters, Path of pollutants, Pollutant transport, Sand aquifers.

Groundwater sulfate that occurs at concentrations of 6-27 mg/L in a shallow water table sand aquifer at a forested site 100 km east of Sudbury, Ontario, was used to deduce the trend in atmospheric sulfur deposition between 1950 and 1985. The simple geologic nature of the aquifer made feasible this trend reconstruction. The age of groundwater that entered the aquifer during the past 60 yr was determined with unusual accuracy (+or-3 yr) from tritium analyses and flow modeling. Sulfur isotopes and mass balances indicate that the sulfate in the groundwater zone is of atmospheric origin and is not derived from solid phase material in the sediments. Evapotranspiration enriches atmospheric sulfate by a factor of about three as it enters the aquifer. Adsorption of sulfate is not significant. Groundwater sulfate indicates a decrease of 37% in sulfur deposition at the site between a maximum in the 1960s and lower values observed in the 1980s. Most of this decrease is attributed to the decrease (about 80%) to lower SO2 emissions from the Sudbury smelters. These emissions are now about one third of the 1960s levels. Further major decreases in sulfur deposition at this site can be achieved only if emissions from sources distant from Sudbury are lowered also because Sudbury now contributes less than 25% of total sulfur deposition. (Author's abstract)
W89-11754

GENERALIZED TWO-DIMENSIONAL ANALYTICAL SOLUTION FOR HYDRODYNAMIC DISPERSION IN BOUNDED MEDIA WITH THE FIRST-TYPE BOUNDARY CONDITION AT THE SOURCE,
International Technology Corp., Monroeville, PA.
V. Batu.
Water Resources Research WRERAO, Vol. 25, No. 6, p 1125-1132, June 1989. 4 fig, 1 tab, 18 ref.

Descriptors: *Groundwater movement, *Groundwater pollution, *Solute transport, *Path of pollutants, *Porous media, *Model studies, Mathematical equations, Strip sources, Rivers, Canals, Mathematical studies, Hydrodynamics, Dispersion, Mathematical models, Hydraulic models.

A generalized two-dimensional analytical solution is developed for hydrodynamic dispersion in a unidirectional-bounded surface and subsurface media flow field from time-dependent and space-dependent sources with the first-type boundary condition at the source. Longitudinal and transverse dispersion, radioactive decay, and linear adsorption are considered. In the mathematical analysis, Laplace transform and Fourier analysis techniques are used simultaneously, and a general equation, in infinite series form, for the unsteady-state concentration distribution are obtained. Solution for a single-strip source is obtained as a special case from the general solution. The equations for convective-dispersive flux components also are derived. The solution obtained by Bruch and Street and published in 1967 for a symmetrically-located strip source is shown to be a special case of the solution. Expressions for concentration distribution and convective-dispersive flux components for the steady-state solute transport case also are presented. The results are compared with two different finite element codes with a good agreement. The results of this model may be used for solute transport in a unidirectional porous media flow field and in rivers and canals (with some additional assumptions). The solutions also can be used for numerical model validation. (Author's abstract)
W89-11755

SYMMETRIC-MATRIX TIME INTEGRATION SCHEME FOR THE EFFICIENT SOLUTION OF ADVECTION-DISPERSION PROBLEMS,
Karlsruhe Univ. (Germany, F.R.). Inst. fuer Hydromechanik.
H. M. Leismann, and E. O. Frind.
Water Resources Research WRERAO, Vol. 25, No. 6, p 1133-1139, June 1989. 6 fig, 1 tab, 5 ref.

Descriptors: *Groundwater movement, *Solute transport, *Mathematical analysis, *Path of pollutants, *Groundwater pollution, Advection-dispersion equation, Precision, Performance evaluation, Algorithms, Mathematical equations.

A new time integration scheme for the time-marching numerical solution of the advection-dispersion equation is formulated. The scheme leads to a symmetric positive-definite coefficient matrix that can be solved with any symmetric matrix solver. Matrix symmetry is achieved by placing the advective term in the old time level. The resulting numerical errors are minimized by introduction of an artificial diffusion term and by optimal time weighting of all terms on the basis of a Taylor expansion of the governing differential equation. The scheme is unconditionally stable and effectively second-order accurate, giving results equivalent to those obtained with the Crank-Nicolson scheme. The use of highly efficient symmetric versions of iterative solution techniques, such as the conjugate gradient method, in the solution of advection-dispersion problems thus becomes possible. Such techniques can provide substantial advantages in the case of grids with large numbers of nodal points, particularly in three dimensions. (Author's abstract)
W89-11756

CONTAMINANT TRANSPORT AND BIODEGRADATION: 1. A NUMERICAL MODEL FOR REACTIVE TRANSPORT IN POROUS MEDIA.
Massachusetts Inst. of Tech., Cambridge. Dept. of Civil Engineering.
M. A. Celia, J. S. Kindred, and I. Herrera.
Water Resources Research WRERAO, Vol. 25, No. 6, p 1141-1148, June 1989. 4 fig, 19 ref. NSF Grant 8657419-CES and MIT Sloan Foundation Grant 26950.

Descriptors: *Fate of pollutants, *Path of pollutants, *Model studies, *Groundwater pollution, Biodegradation, Numerical models, Model studies, Solute transport, Reactive transport, Porous media, Advection, Diffusion, Chemical reactions, Algorithms.

A new numerical solution procedure is presented for simulation of reactive transport in porous media. The new procedure, which is referred to as an optimal test function (OTF) method, is formulated so that it systematically adapts to the changing character of the governing partial differential equation. Relative importance of diffusion, advection, and reaction are directly incorporated into the numerical approximation by judicious choice of the test, or weight, function that appears in the weak form of the equation. Specific algorithms are presented to solve a general class of nonlinear, multispecies transport equations. This includes a variety of models of subsurface contaminant transport with biodegradation. (See also W89-11758) (Author's abstract)
W89-11757

CONTAMINANT TRANSPORT AND BIODEGRADATION: 2. CONCEPTUAL MODEL AND TEST SIMULATIONS.
Golder Associates, Inc., Redmond, WA.
J. S. Kindred, and M. A. Celia.
Water Resources Research WRERAO, Vol. 25, No. 6, p 1149-1159, June 1989. 5 fig, 37 ref, 2 append. NSF Grant 8657419-CES and MIT Sloan Foundation Grant 26950.

Descriptors: *Fate of pollutants, *Path of pollutants, *Model studies, *Groundwater pollution, *Biodegradation, Nutrition, Model studies, Solute transport, Kinetics, Reactive transport, Porous media, Simulation.

A conceptual model of subsurface contaminant transport with biodegradation incorporates both aerobic and anaerobic reactions, with several models of differing complexity presented of the anaerobic case. Nutrient uptake is described using Michaelis-Menten expressions, which are incorporated into a multiple nutrient uptake model. Several uptake inhibition factors also are included in the model. The mathematical model that results takes the form of a series of reactive transport equations. These equations are coupled nonlinearly through the reaction terms, which are themselves coupled to growth equations for subsurface bacterial populations. Example simulations are presented for a variety of cases ranging from one-substrate, one-population aerobic degradation to multisubstrate,

multipopulation anaerobic consortium degradation. (See also W89-11757) (Author's abstract)
W89-11758

WETTING FRONT INSTABILITY: 1. THEORETICAL DISCUSSION AND DIMENSIONAL ANALYSIS.
New York State Coll. of Agriculture and Life Sciences, Ithaca. Dept. of Agricultural and Biological Engineering.
For primary bibliographic entry see Field 2G.
W89-11760

WETTING FRONT INSTABILITY: 2. EXPERIMENTAL DETERMINATION OF RELATIONSHIPS BETWEEN SYSTEM PARAMETERS AND TWO-DIMENSIONAL UNSTABLE FLOW FIELD BEHAVIOR IN INITIALLY DRY POROUS MEDIA.
New York State Coll. of Agriculture and Life Sciences, Ithaca. Dept. of Agricultural and Biological Engineering.
For primary bibliographic entry see Field 2G.
W89-11761

ANALYTICAL MODEL OF CONTAMINANT TRANSPORT FROM DIFFUSE SOURCES IN SATURATED POROUS MEDIA,
Commonwealth Scientific and Industrial Research Organization, Adelaide (Australia). Div. of Water Resources.
P. J. Dillon.
Water Resources Research WRERAO, Vol. 25, No. 6, p 1208-1218, June 1989. 12 fig, 22 ref.

Descriptors: *Nonpoint pollution sources, *Path of pollutants, *Model studies, *Solute transport, *Groundwater pollution, DIVAST model, Analytical methods, Groundwater movement, Comparison studies, Performance evaluation, Numerical analysis, Australia, Aquifers.

An analytical two-dimensional model of solute transport along a vertical cross section of an aquifer is described. The model, named DIVAST, for diffuse-source vertical analytical solute transport, extends analytical methods to two-dimensional dispersive solute transport in a two-dimensional flow field, which until now has been the exclusive province of numerical models. This avoids the very significant problems of numerical instability and numerical dispersion facing the application of numerical transport at a regional scale. Furthermore, the model is simple and very fast. A novel feature is the segregation of longitudinal and transverse transport components. The model is intended for preliminary evaluation of groundwater quality on a regional scale in areas subject to diffuse sources of contamination. It gives vertical resolution of contaminant concentrations through the aquifer thickness. Results compare favorably with finite element model results for a case involving a strip source of contaminants. DIVAST has been useful in predicting the impact of diffuse-source nitrate contamination on groundwater quality in the Lower South East of Australia. (Author's abstract)
W89-11762

METHODS FOR DETERMINING TRANSVERSE DISPERSION COEFFICIENTS OF POROUS MEDIA IN LABORATORY COLUMN EXPERIMENTS.
Connecticut Univ., Storrs. Dept. of Geology and Geophysics.
For primary bibliographic entry see Field 2F.
W89-11766

SOLUTE ADVECTION IN STRATIFIED FORMATIONS.
Royal Inst. of Tech., Stockholm (Sweden).
For primary bibliographic entry see Field 2F.
W89-11769

NATURAL AND ANTHROPOGENIC COMPONENTS IN BULK PRECIPITATION AT BLIDO (ARCHIPELAGO OF STOCKHOLM).
Stockholm Univ. (Sweden). Dept. of Geology.
K. Bostrom, B. Bostrom, and P. Andersson.
Water Resources Research WRERAO, Vol. 25, No. 6, p 1291-1301, June 1989. 9 fig, 7 tab, 45 ref.

Descriptors: *Air pollution, *Sweden, *Path of pollutants, *Water pollution sources, *Precipitation, *Cycling nutrients, Stockholm Archipelago, Blido Island, Phosphorus, Potassium, Manganese, Barium, Calcium, Magnesium, Silicon, Titanium, Sulfur, Zinc, Sodium, Aluminum, Strontium, Acid rain, Seasonal variation, Biogeochemistry, Hydrologic models.

Analyses of 37 precipitation samples obtained at Blido, an island in the Stockholm archipelago, collected in the period 1984-1987 reveal distinct seasonal variations. Particularly, P and K, as well as Mn, Ba, Ca, and Mg, are enriched in rain during the early growth season, whereas Na is enriched in rains near the end of the year due to storm activity at sea. Semiconservative mixing models involving (SW), plant matter (PLM), terrigenous matter (TM), and coal emissions (CEM) suggest that PLM supplies 99-20% of the P, K, Mn, Ba, Ca, Sr, and Mg. SW explains 99-35% of Na and Mg, and TM the major fraction of Al, Fe, Ti, and Si. However, 90-65% of S and Zn are in excesses compared to the models; probably these elements arrive in anthropogenic phases. These mixing models explain the complex sources of rain components better than conventional enrichment factors. The results appear representative for Northern Europe, but other areas of the world probably show different input ratios of PLM, SW, TM, and CEM. (Author's abstract)
W89-11770

PREDICTION OF PHOSPHATE TRANSPORT IN SMALL COLUMNS WITH AN APPROXIMATE SORPTION KINETICS MODEL.
Agricultural Univ., Wageningen (Netherlands). Dept. of Soil Science and Plant Nutrition.
S. van der Zee, F. Leus, and M. Louer.
Water Resources Research WRERAO, Vol. 25, No. 6, p 1353-1365, June 1989. 6 fig, 3 tab, 49 ref.

Descriptors: *Phosphates, *Soil contamination, *Water pollution sources, *Path of pollutants, *Solute transport, Adsorption, Diffusion precipitation, Hydrogen ion concentration, Mathematical models, Hydrologic models, Mathematical equations, Prediction, Chemical reactions.

The reaction of phosphate (P) with soil is described with two processes: adsorption and diffusion precipitation. In the case of small pH variations in the acid range (pH 4.5-6.5), P adsorption may be described with a Langmuir equilibrium or Langmuir kinetics equation. The diffusion-precipitation process is described with an expression taking the effects of P concentration and reaction time into account. This description is based on the unreacted shrinking core model, where the metal oxides are converted into metal phosphates, and these two phases are separated by a sharp interface inside the particles. For an evaluation of the predictive capabilities of the sorption model, P transport in small columns is predicted, using independently assessed sorption and transport parameters. These predictions are compared to experimental data. The predicted P breakthrough curves agree well overall with the experimental results obtained by percolation of a pulse of a P solution. The main difference between predicted and experimental breakthrough is observed in the sorption stage of the pulse with a feed concentration (c sub 0) of 0.2 mole P/cu m. After initial breakthrough, the correspondence between the prediction and the data is good for triplicated experiments at c sub 0 = 0.2 mole/cu m. At high feed concentrations (c sub 0 = 3 mole/cu m) only small differences between prediction and experiment are observed in the desorption stage of the concentration pulse. For experiments involving a first pulse at c sub 0 = 3 mole/cu m, followed by two pulses at c sub 0 = 0.2 mole/cu m the same agreement of numerical and experimental breakthrough curves is found as for the experiments involving only one pulse. Because P transport involving both sorption and desorption stages was modeled reasonably for two different concentrations, it is concluded that the P sorption model accurately describes the reactions of P with soil. (Author's abstract)
W89-11775

ACIDIFICATION OF NATIVE BROOK TROUT STREAMS IN VIRGINIA.
Virginia Univ., Charlottesville. Dept. of Environmental Sciences.
J. R. Webb, B. J. Cosby, J. N. Galloway, and G. M. Hornberger.
Water Resources Research WRERAO, Vol. 25, No. 6, p 1367-1377, June 1989. 8 fig, 3 tab, 62 ref. Federal Aid in Fish Restoration Act (PL81-681) Project F-72-R-1.

Descriptors: *Acid rain effects, *Virginia, *Trout, *Acidic water, *Aquatic habitats, Appalachian Mountains, Alkalinity, Sulfates, Acid rain, Model studies, Prediction, Cations, Spawning, Fisheries.

A survey of 344 streams in the Appalachian Mountain region of Virginia that support reproducing populations of native brook trout (Salvelinus fontinalis) was conducted in the spring of 1987. The surveyed streams represent about 76% of the identified trout streams in the region. Relative to commonly applied sensitivity criteria, 93% of the streams are sensitive (alkalinity 200 microequivalents/L or less), 49% of the streams are extremely sensitive (alkalinity 50 microequivalents/L or less) and 10% of the streams are currently acidic (alkalinity zero or less). Sulfate is the dominant anion in the streams, but all catchments associated with the streams are retaining significant amounts of atmospherically deposited sulfur (median retention = 68%). Estimates of past and potential future acidification were obtained using a simple linear model relating changes in concentrations of base cations to changes in concentrations of sulfate. Sulfate concentration changes were determined as the difference between currently observed concentrations and estimated past and future steady-state concentrations. Changes in concentrations of base cations were calculated, assuming base cation increase factors equal to 0.4 and 0.8 times the sulfate increase. The median historical alkalinity loss for the sampled population is estimated as 29 and 9 microequivalent/L for the assumed to factors, with 3% and 0% of the streams estimated to have had historical alkalinities less than 0.0 microequivalent/L. The median future alkalinity loss is estimated as 90 and 30 microequivalent/L for the two assumed factors, with 88% and 32% of the streams estimated to have future alkalinities less than 0 microequivalent/L. (Author's abstract)
W89-11776

EVALUATION OF METHODS FOR THE ESTIMATION OF TRIBUTARY MASS LOADS,
Notre Dame Univ., IN. Dept. of Civil Engineering.
S. D. Preston, V. J. Bierman, and S. E. Silliman.
Water Resources Research WRERAO, Vol. 25, No. 6, p 1379-1389, June 1989. 10 fig, 5 tab, 20 ref.

Descriptors: *Path of pollutants, *Water pollution sources, *Michigan, *Pollution load, *Mathematical studies, *Sampling, *Annual runoff, Monte Carlo method, Flow rates, Heavy metals, Polychlorinated biphenyls, Nutrients, Saginaw River, Grand River, Performance evaluation, Hydrographs, Errors, Tributaries.

Tributary loading estimation methods were evaluated by conducting retrospective studies with comprehensive sets of field data from the Grand and Saginaw Rivers, Michigan, for flow rates, nutrients, heavy metals, and polychlorinated biphenyls. Three broad classes of loading estimation methods were investigated: simple averaging methods, ratio estimation methods, and regression methods. Estimators were evaluated using Monte Carlo sampling studies in which random subsamples of complete loading records were used to estimate annual loadings. These estimates were then compared to 'true' loadings determined by calculations using the entire record. No group of estimators was superior for all test cases considered. However, individual estimation approaches within each group often provided low error estimates. Results were inconsistent among test cases and these inconsistencies appeared to be related to specific test case charac-

teristics such as the strength and form of the flow-concentration relationship and the nature of the annual hydrograph. Ratio estimators appeared to be more robust to sources of bias than other estimation approaches. (Author's abstract)
W89-11777

EVALUATION OF MATHEMATICAL MODELS OF THE TRANSPORT OF BIOLOGICALLY REACTING SOLUTES IN SATURATED SOILS AND AQUIFERS.
Illinois Univ. at Urbana-Champaign. Dept. of Agronomy.
P. Baveye, and A. Valocchi.
Water Resources Research WRERAO, Vol. 25, No. 6, p 1413-1421, June 1989. 4 fig, 1 tab, 39 ref. Illinois Water Resources Center Grants S-109-ILL and S-111-ILL and Illinois Hazardous Waste Research and Information Center Grant 88026.

Descriptors: *Path of pollutants, *Fate of pollutants, *Groundwater pollution, *Solute transport, *Bacteria, *Model studies, *Biodegradation, Interstices, Colony geometry, Biofilms, Microcolonies, Theory, Mathematical models, Mathematical equations, Microenvironment.

Three different conceptual frameworks have been adopted in the past for the development of mathematical models of bacterial growth and biologically reacting solute transport in saturated porous media. Two schools of thought are based on assuming that the pore-scale geometrical configuration of the attached bacteria consists of biofilms or microcolonies; a third school of thought represents that traditional approach, where pore-scale processes are neglected and the bacteria are assumed to respond to the macroscopic bulk fluid substrate concentration. On the basis of a schematic block diagram representation of a saturated porous medium hosting a microbial population, it is shown that these frameworks share a common theoretical foundation, and that they differ only by the choice of particular constitutive equations for several transfer parameters. Using one possible option in this respect, a mathematical model is derived that involves no unwarranted assumption about the distribution of the microorganisms in the pore space. The governing equations of this model are fundamentally identical to (1) those obtained earlier by F. J. Molz and associates using the concept of the microcolony and (2) those that would result from adopting a simple form of biofilm model to describe bacterial growth in the pore space. Whether the 'strictly macroscopic', 'microcolony', or 'biofilm' model is chosen has important practical consequences. The strictly macroscopic model has the advantage that it does not require any assumption to be made about the microscopic scale of the bacteria, it does involve a macroscopic variable, S sub im (macroscopic intrinsic concentration of the growth-limiting substrate in the immobile water) that cannot be evaluated experimentally. Measured values of S sub im are not required to fit the model, would be needed for direct evaluation of the interphase transfer coefficient. (Rochester-PTT)
W89-11780

ESTIMATED BACKGROUND CONCENTRATIONS OF SULFATE IN DILUTE LAKES.
Western Washington Univ., Bellingham. Inst. for Watershed Studies.
D. F. Brakke, A. Henriksen, and S. A. Norton.
Water Resources Bulletin WARBAQ, Vol. 25, No. 2, p 247-253, April 1989. 2 fig, 1 tab, 52 ref. EPA Contract CR-810652-01-2.

Descriptors: *Acid rain, *Sulfates, *Lakes, *Path of pollutants, *United States, *Norway, Calcium, Magnesium, Hydrogen ion concentration, Chemical analysis.

Lake water sulfate values were examined for two areas in western Norway and the western United States presently receiving low levels of sulfate in atmospheric deposition. Data from these areas were used to estimate background concentrations of sulfate in lakes found in areas currently receiving acidic deposition. The two areas contain dilute lakes with concentrations of sea-salt corrected Ca + Mg < 50 microequivalents (ueq)/L or conductivity < 10 microSiemens /cm and receive precipitation with volume-weighted mean pH > 4.8. Based on observations from these areas, it is concluded that background sulfate concentrations were probably no more than 10 to 15 ueq/L for areas of Norway and the United States containing lakes with low concentrations of base cations. For southern Norway and the northeastern U.S., present lake-water sulfate concentrations represent an increase of 7 to 10 fold above these estimated background values. (Author's abstract)
W89-11785

INTERPLAY BETWEEN PARAMETER UNCERTAINTY AND MODEL AGGREGATION ERROR.
Texas Univ. at Dallas, Richardson. Graduate Program in Environmental Sciences.
J. J. Warwick.
Water Resources Bulletin WARBAQ, Vol. 25, No. 2, p 275-283, April 1989. 5 fig, 1 tab, 13 ref.

Descriptors: *Water quality, *Model studies, *Error analysis, *Parametric hydrology, Monte Carlo method, Mathematical studies.

Modeling error can be divided into two basic components: use of an incorrect model, and input parameter uncertainty. Incorrect model usage can be further subdivided into inappropriate model selection and inherent modeling error due to process aggregation. Total modeling error is a culmination of these various modeling error components, with overall optimization requiring reductions in all. A technique, utilizing Monte Carlo analysis, was employed to investigate the relative importance of input parameter uncertainty versus process aggregation error in mathematical models used for water quality simulation. An expanded form of the Streeter-Phelps dissolved oxygen equation was used to demonstrate the application of this technique. A variety of scenarios were analyzed to illustrate the relative obfuscation of each modeling error component. Under certain circumstances an aggregated model performs better than a more complex model, which perfectly simulates the real system. Alternately, process aggregation error dominates total modeling error for other situations. The ability to differentiate modeling error impact is a function of the desired or imposed model performance level (accuracy tolerance). (Author's abstract)
W89-11788

GROUNDWATER CONTAMINATION BY NEMATICIDES: INFLUENCE OF RECHARGE TIMING UNDER PINEAPPLE CROP.
Hawaii Univ. at Manoa, Honolulu. Water Resources Research Center.
D. S. Oki, and T. W. Giambelluca.
Water Resources Bulletin WARBAQ, Vol. 25, No. 2, p 285-294, April 1989. 8 fig, 4 tab, 28 ref.

Descriptors: *Pesticides, *Path of pollutants, *Water pollution sources, *Hawaii, *Groundwater pollution, *Nematicides, *Groundwater recharge, *Pineapples, Fate of pollutants, Agricultural chemicals, Path of pollutants, Organic compounds, Dibromochloropropane, Dibromoethane, Trichloropropane, Soil contamination.

Toxic organic compounds, such as 1,2-dibromo-3-chloropropane (DBCP), 1,2-dibromoethane (EDB), and 1,2,3-trichloropropane (TCP), that are associated with pineapple cultivation in Hawaii, have been discovered in drinking water wells on Oahu. In order to reach and contaminate the Pearl Harbor aquifer, pesticides must be transported quickly downward away from the soil surface prior to complete volatilization, degradation, or adsorption of residuals. A study assessed the role of pesticide application timing relative to subsequent rainfall-induced recharge events in determining the amount and extent of chemical leaching from the soil. A water balance model for a pineapple crop was developed to estimate the time series of recharge from two fields for which soil contamination profiles were available. In general, the amounts of DBCP, EDB, and TCP found in the soil profiles of the two field are consistent with expectations of leaching based on an analysis of the recharge time series. The results indicate that recharge during and immediately following the application of pesticides is important in determining whether groundwater contamination will result. (Author's abstract)
W89-11789

OPTIMAL ESTIMATION OF CONTAMINANT TRANSPORT IN GROUND WATER.
Kansas Univ., Lawrence. Dept. of Civil Engineering.
Y.-S. Yu, M. Heidari, and W. Guang-Te.
Water Resources Bulletin WARBAQ, Vol. 25, No. 2, p 295-300, April 1989. 3 fig, 1 tab, 18 ref.

Descriptors: *Solute transport, *Groundwater pollution, *Path of pollutants, *Mathematical studies, Finite element method, Finite difference methods, Model studies, Groundwater movement, Kalman filter method.

Finite element and finite difference representation of the convective-dispersive equation have been widely used in determining contaminant transport in groundwater. Due to inherent uncertainties of the transport process, those representations are inexact and contain errors. Errors in field measurements are unavoidable. By combining a numerical model, a measurement equation, and the Kalman filter, optimal estimates of the state variable (contaminant concentration) can be obtained. The Kalman filter algorithm is described and a numerical example of contaminant transport in a two-dimensional groundwater flow is given. The results show significant improvement in the estimated concentration distribution by using the filtering technique compared to the analytical and finite element solution. (Author's abstract)
W89-11790

LONGITUDINAL DISPERSION IN RIVERS: A DEAD-ZONE MODEL SOLUTION.
Kansas Univ., Lawrence. Dept. of Civil Engineering.
Y.-S. Yu, and L. Wenzhi.
Water Resources Bulletin WARBAQ, Vol. 25, No. 2, p 319-325, April 1989. 4 fig, 1 tab, 25 ref.

Descriptors: *Path of pollutants, *Flow profiles, *River flow, *Model studies, Mathematical equations, Tracers, Mathematical studies, Mississippi River, Saline River, Missouri River.

The longitudinal dispersion of tracer material in rivers was simulated by a dead-zone model that involves two coupled differential equations. For an instantaneous injection of tracer material, the problem was solved by the Laplace transform and numerical inversion to obtain the time-concentration curve at any sampling station. The optimal values of the model parameters were estimated from field measurements. Applications of the model to the Missouri, the Mississippi, and the Saline Rivers generally show that the model reproduces the longitudinal dispersion characteristics in natural streams with sufficient accuracy. (Author's abstract)
W89-11793

DEVELOPMENT OF A BACTERIAL TRANSPORT MODEL FOR COARSE SOILS.
Bioreclamation Assessments Group, Fort Collins, CO.
T. C. Peterson, and R. C. Ward.
Water Resources Bulletin WARBAQ, Vol. 25, No. 2, p 349-357, April 1989. 3 fig, 1 tab, 48 ref.

Descriptors: *Path of pollutants, *Bacteria, *Model studies, *Soil contamination, Mathematical equations, Hydraulic conductivity, Monte Carlo method, Simulation analysis, Clays, Soil water, Water temperature.

A bacterial transport model, developed to analyze bacterial translocation in coarse-grained soils, is presented. The complex governing equation is presented first, followed by analyses of each of the major processes influencing bacterial transport. These analyses suggest simplification of the gov-

erning equation is feasible when input data on specific processes are limited or unavailable. Model parameters, including bacterial die-off, bacterial distribution, input bacterial concentrations, and saturated hydraulic conductivity, were randomly generated using a procedure known to produce either a normal or log-normal distribution of random numbers. Monte Carlo simulations were completed and the resulting output was used to generate cumulative frequency distributions showing the probability of bacterial transport beyond various soil depths. Results from these simulations indicate that bacteria have a high probability of traveling through coarse-grained soils when low clay content and soil water temperatures limit bacterial retention and die-off. (Author's abstract)
W89-11797

MANGANESE OXIDATION MODEL FOR RIVERS,
Geological Survey, Doraville, GA.
G. W. Hess, B. R. Kim, and P. J. W. Roberts.
Water Resources Bulletin WARBAQ, Vol. 25, No. 2, 359-365, April 1989. 5 fig, 2 tab, 21 ref.

Descriptors: *Water chemistry, *Manganese, *Natural waters, *Path of pollutants, Oxidation, Model studies, Dissolved oxygen, Biochemical oxygen demand, Hydrogen ion concentration, Duck River, Water quality, Tennessee, Chattahoochee River, Georgia, Sediment transport.

The presence of manganese in natural waters (> 0.05 mg/L) degrades water supply quality. A model was devised to predict the variation of manganese concentrations in river water released from an impoundment with the distance downstream. The model is one-dimensional and was calibrated using dissolved oxygen, biochemical oxygen demand, pH, manganese, and hydraulic data collected in the Duck River, Tennessee. The results indicated that the model can predict manganese levels under various conditions. The model was then applied to the Chattahoochee River, Georgia. The model closely predicted dissolved manganese concentrations in the Chattahoochee River at similar pH conditions to those observed in the Duck River. However, there was some disagreement between the model predictions and the observed data obtained at low pH conditions (<7). These discrepancies may be due to inadequate pH data, precipitation of sediment particles, unsteady flow conditions in the Chattahoochee River, inaccurate rate expressions for the low pH conditions, or their combinations. (Lantz-PTT)
W89-11798

CYCLIC ORGANOCHLORIDES IN PLANKTON FROM THE NORTH SEA IN SPRING.
Hamburg Univ. (Germany, F.R.). Inst. fuer Biochemie und Lebensmittelschemie.
R. Knickmeyer, and H. Steinhart.
Estuarine, Coastal and Shelf Science ECSSD3, Vol. 28, No. 2, p 117-127, February 1989. 6 fig, 40 ref.

Descriptors: *Chlorinated hydrocarbons, *Path of pollutants, *Polychlorinated biphenyls, *Benzenes, *DDE, *Coastal waters, *Plankton, *North Sea, Cyclic compounds, Organic pesticides, Lipids, Lindane, Copepods.

The body burden of five cyclic organochlorines on the basis of n-hexane extractable lipids (sum of 24 PCB congeners, alpha-HCH, beta-HCH, HCB, p'-DDE) were determined in the North Sea plankton during the declining spring plankton bloom. The PCB patterns of Calanus finmarchicus and Temora longicornis are dominated by low chlorinated congeners. Ingestion of suspended matter as well as geo-distribution of congeners may increase the levels of higher chlorinated PCBs in Temora longicornis. The geographical differences in concentrations of the sum of PCB show higher concentrations at the British Continental coasts, the Doggerbank and the region near Bergen. Maximum concentrations of HCB and p,p'-DDE were found at stations on the Continental Coast. Humber, Thames, Rhine, Ems as well as the region near Bergen are sources of Lindane pollution in the North Sea. The increasing alpha/beta-HCH ratio running from south to north in the North Sea may evidence Lindane degradation or isometrization in the marine environment. (Author's abstract)
W89-11807

DIFFERENTIAL UPTAKE OF ZINC, COPPER, AND LEAD IN TEXAS CICHLID (CICHLASOMA CYANOGUTTATUM).
Mexican Inst. of Social Security, Monterrey. Northeast Biological Research Unit.
A. Villegas-Navarro, and C. M. Villerreal-Trevino.
Bulletin of Environmental Contamination and Toxicology BECTA6, Vol. 42, No. 5, p 761-768, March 1989. 3 tab, 14 ref.

Descriptors: *Path of pollutants, *Cichlid, *Bioaccumulation, *Fish, *Zinc, *Copper, *Lead, Lakes, Rivers, Tissue analysis, Stream fisheries, Heavy metals.

Differential uptake of Zn, Cu, and Pb by the Texas cichlid (Cichlasoma cyanguttatum) and differential accumulation of these metals between muscle viscera, gill and bone were determined. These metals were selected because most studies on heavy metal concentrations in fishes have examined one or more of these elements and because they are found in aquatic environments as natural and industrial contaminants. The fish species was chosen on the basis of its relative abundance in Nuevo Leon State, its importance as a sport fish, as a source of food, and its frequent use in laboratory studies. The following conclusions were postulated: (1) differential accumulation of Zn, Cu, and Pb in tissues of the Texas cichlid was found to take place in the following order: bone < gill < viscera < muscle, (2) differential uptake was shown by the Texas cichlid; Zn was highly taken up by the fish in comparison with Cu and Pb, (3) a notable bioaccumulation of all studied elements was shown. Although the study cannot specify all factors determining the fate of individual metals in the body, it demonstrates that differential accumulation and differential uptake of the three metals examined is vastly different. This diversity of pathways whereby the organism disposes of metals is important information in selecting rational therapy for metal intoxication. (Miller-PTT)
W89-11813

VOLATILIZATION OF FLUORESCEIN MERCURIC ACETATE BY MARINE BACTERIA FROM MINAMATA BAY.
National Inst. for Minamata Disease, Minamata (Japan). Dept. of Basic Medical Science.
K. Nakamura.
Bulletin of Environmental Contamination and Toxicology BECTA6, Vol. 42, No. 5, p 785-790, March 1989. 2 fig, 1 tab, 16 ref.

Descriptors: *Biotransformation, *Mercury, *Minamata Bay, *Fate of pollutants, *Path of pollutants, *Marine bacteria, Fluorescein mercuric acid, Tolerance, Human diseases, Sediment contamination.

The mechanism of resistance to flourescein mercuric acetate (FMA) of the FMA-resistant bacteria living in the Minamata Bay is determined. Minamata Bay has been heavily polluted by mercury, which has caused methylmercury poisoning in humans, called Minamata disease. Sediments from the Bay still contain high concentrations of mercury. The percentage of mercury-resistant bacteria in the total bacterial count is higher in these sediments than in those of other marine environments. FMA-pollution, however, has not been reported. It is concluded that FMA-resistant bacteria transform both FMA and mercury chloride into vaporized metal mercury through bacterial volatilization. It is shown that FMA is very likely transformed into fluorescein, acetic acid and Hg through the volatilization. The study of the bacterial volatilization of FMA by 322 FMA-resistant strains isolated from Minamata Bay showed that all strains failed to produce mercury precipitate in a liquid culture containing 5 microg/ml of FMA within 48 hr. However, of 322 strains, 144 (43.9%) were able to volatilize the FMA in a similar liquid culture within 48 hr. These strains belong to the following genera: Bacillus, Micrococcus, Corynebacterium, Staphylococcus, Pseudomonas, Moraxella, Vibrio, Enterobacter, and Flavobacterium. The volatilization of FMA was observed in all bacterial genera tested. The results suggest that bacteria more commonly volatilize FMA rather than produce precipitates. (Miller-PTT)
W89-11815

METABOLISM OF POLYCYCLIC AROMATIC HYDROCARBONS IN THE AQUATIC ENVIRONMENT.
CRC Press, Inc., Boca Raton, Florida. 1989. 341 p. Edited by Usha Varanasi.

Descriptors: *Biotransformation, *Hydrocarbons, *Fate of pollutants, *Polycyclic aromatic hydrocarbons, *Aquatic environment, *Biodegradation, Path of pollutants, Microbial degradation, Bioaccumulation, Field tests, Toxicity, Metabolism, Ecological effects, Carcinogens.

During the past decade, knowledge of polycyclic aromatic hydrocarbons (PAH) in the aquatic environment has advanced substantially to encompass studies of bioavailability, metabolism, subsequent toxic effects, and their ecological consequences. In this book, recent advances in the areas of PAH biogeochemistry and bioaccumulation, microbial degradation, enzymes of activation and detoxication, metabolism of PAH, and laboratory and field studies on carcinogenic/toxic effects, are presented. Additionally, important similarities and differences in metabolism of PAH by aquatic and terrestrial organisms are discussed. These chapters also illustrate that although considerable progress has been made in certain areas of PAH metabolism in the aquatic environment, the field is relatively unexplored and many exciting possibilities exist for future investigations. (See W89-11827 thru W89-11836) (Lantz-PTT)
W89-11826

BIOAVAILABILITY OF POLYCYCLIC AROMATIC HYDROCARBONS IN THE AQUATIC ENVIRONMENT.
Massachusetts Univ. at Boston. Environmental Science Program.
A. E. McElroy, J. W. Farrington, and J. M. Teal.
IN: Metabolism of Polycyclic Aromatic Hydrocarbons in the Aquatic Environment. CRC Press, Inc., Boca Raton, Florida. 1989. p 1-39, 14 fig, 9 tab, 159 ref. NOAA Contract 83-ABD-00012.

Descriptors: *Bioavailability, *Path of pollutants, *Hydrocarbons, *Fate of pollutants, *Polycyclic aromatic hydrocarbons, *Aquatic environment, Bioaccumulation, Water pollution sources, Chemical reactions, Metabolism, Aquatic life.

The primary goal of this chapter is to review what is known about the bioavailability of polynuclear aromatic hydrocarbons or polycyclic aromatic hydrocarbons (PAH) and their metabolites in the aquatic environment. Emphasis will be placed on the physical/chemical, biological, and environmental factors which drive these processes. Second, this discussion provides a rationale for why it is important to study metabolism when considering the fate of PAH in aquatic systems. The chapter is divided into three main sections. The first introduces PAH, their sources, transformations, and sinks, and the physical/chemical factors which influence their cycling in the environment. The second section reviews information gathered from field studies on the bioavailability of PAH to aquatic organisms. Information derived from laboratory investigations on processes influencing bioavailability is discussed in the third section. Due to the complexity of the many parameters which influence the fate of compounds such as PAH in the environment, studies of these processes in the field are required to obtain a realistic assessment of the environmental fate of PAH. For the same reasons it is very difficult and often impossible to do controlled experiments in the field. Therefore, this study focuses on field-collected data on PAH bioavailability, supplemented with discussions and information derived from laboratory studies. (See also W89-11826) (Lantz-PTT)
W89-11827

MICROBIAL DEGRADATION OF POLYCYCLIC AROMATIC HYDROCARBONS (PAH) IN THE AQUATIC ENVIRONMENT.
National Center for Toxicological Research, Jefferson, AR.
C. E. Cerniglia, and M. A. Heitkamp.
IN: Metabolism of Polycyclic Aromatic Hydrocarbons in the Aquatic Environment. CRC Press, Inc., Boca Raton, Florida. 1989. p 41-68, 111 fig, 3 tab, 114 ref.

Descriptors: *Hydrocarbons, *Microbial degradation, *Fate of pollutants, *Biodegradation, *Polycyclic aromatic hydrocarbons, *Aquatic environment, Organic compounds, Temperature, Molecular structure, Chemical reactions, Sediment contamination, Cycling nutrients, *Adaptation, Air pollution, Soil contamination, Water pollution, Carcinogens, Adsorption.

Microorganisms play an important role in recycling of elements such as carbon, nitrogen, phosphorus, oxygen, and sulfur and in the degradation of organic compounds to carbon dioxide and water in nature. Microorganisms have adapted to the wide array of natural and synthetic organic compounds emitted into the environment and possess enzymes that utilize some of these compounds as nutrients. In recent years, the concern about the presence of polycyclic aromatic hydrocarbons (PAH) in air, soil, and water systems has increased, since this important class of chemicals is carcinogenic in experimental animals and a potential health risk to man. PAH are mainly formed as products from the combustion of fossil fuels and also occur as natural constituents of unaltered fossil fuels. Due to their hydrophobic properties and limited water solubility, PAH tend to adsorb to particulates and eventually migrate to the sediments in river, lake, estuarine, and marine waters. Lower molecular weight PAH, such as naphthalene and its alkylated derivatives, are relatively water soluble, but PAH containing three or more fused benzene rings, due to their hydrophobic nature, are bound and transported by fine particles and dissolved organic matter in aquatic environments. Although PAH may undergo volatilization, photodecomposition, and degradation while in open waters, most sediment deposition occurs below the photolytic zone, and the primary factor affecting the persistence of deposited PAH is microbial degradation. To date, most studies have examined the biodegradation of naphthalene, anthracene, phenanthrene, benz(a)anthracene, or benzo(a)pyrene. Some limited data are available for the biodegradation of 2-methylnaphthalene, dimethylbenz(a)anthracene, pyrene, fluorene, and chrysene, but little or no data exist for other common PAH and their alkylated derivatives. Relationships have been shown to exist between the rate of PAH biodegradation in aquatic ecosystems and the chemical structure and molecular weight of PAH, microbial adaptations occurring from chronic exposure to PAH, oxygen tension, redox potential, and temperature. The effects of these factors on PAH biodegradation in aquatic ecosystems are reviewed in this paper. (See also W89-11826) (Lantz-PTT)
W89-11828

BIOTRANSFORMATION AND DISPOSITION OF PAH IN AQUATIC INVERTEBRATES.
Florida Univ., Gainesville. J. Hillis Miller Health Center.
M. O. James.
IN: Metabolism of Polycyclic Aromatic Hydrocarbons in the Aquatic Environment. CRC Press, Inc., Boca Raton, Florida. 1989. p 69-91, 9 fig, 2 tab, 81 ref.

Descriptors: *Hydrocarbons, *Polycyclic aromatic hydrocarbons, *Aquatic environment, *Fate of polutants, *Biotransformation, *Invertebrates, *Biodegradation, Biochemistry, Metabolism, Metabolites, Polychlorinated biphenyls, Protozoa, Mollusks, Organic compounds, Biological studies, Dioxins.

A combination of in vivo and in vitro studies has shown that cytochrome P-450-dependent monooxygenation, the first step in PAH biotransformation, is usually slower in invertebrates than vertebrates, sometimes proceeding at rates so slow as to be undetectable by many standard techniques; and, furthermore, that PAH metabolites are excreted quite inefficiently by invertebrates. Although there is in vivo evidence for the presence of glycoside and sulfate conjugates of PAH primary metabolites, these pathways have not been studied in vitro in invertebrates. The presence of glutathione conjugates of primary PAH metabolites has not been directly demonstrated in vivo, although in vitro studies have shown the presence of glutathione S-transferases in invertebrates. Monooxygenation of PAH occurred most rapidly in higher invertebrates, such as arthropods, echinoderms, and annelids and very slowly or not at all in the more primitive invertebrates, such as protozoa, porifera, cnidaria, and mollusks. Where metabolism occurred, wide interspecies variations were observed in rates of biotransformation. It is not yet clear if the cytochrome P-450 system is not present in the lower invertebrates, or is simply not functional with the PAH as substrates. There was some evidence that in certain mollusks and annelids the cytochrome P-450 system was able to metabolize PAH only after induction by hydrocarbon mixtures or mixtures of polychlorinated biphenyls. Other studies, however, have failed to demonstrate that the cytochrome P-450 system of crustaceans can be induced by compounds of the 3-methylcholanthrene or tetrachlorodibenzo-p-dioxin (TCDD) type which induce PAH monooxygenation in vertebrate species. More information is needed on PAH biotransformation and the regulation of cytochrome P-450 in invertebrate species before clear conclusions can be drawn concerning the ability of a particular species to biotransform PAH. (See also W89-11826) (Lantz-PTT)
W89-11829

BIOTRANSFORMATION AND DISPOSITION OF POLYCYCLIC AROMATIC HYDROCARBONS (PAH) IN FISH.
National Marine Fisheries Service, Seattle, WA. Northwest and Alaska Fisheries Center.
U. Varanasi, J. E. Stein, and M. Nishimoto.
IN: Metabolism of Polycyclic Aromatic Hydrocarbons in the Aquatic Environment. CRC Press, Inc., Boca Raton, Florida. 1989. p 93-149, 20 fig, 15 tab, 171 ref. NOAA Contract Y01-CP-40507.

Descriptors: *Path of pollutants, *Hydrocarbons, *Fate of pollutants, *Fish, *Biotransformation, *Polycyclic aromatic hydrocarbons, *Path of pollutants, Naphthalenes, Benz(a)pyrenes, Metabolism, Toxicity, Bioaccumulation, Organic compounds, Benzene, Environmental effects, Tissue analysis, Metabolites.

During the early to mid-1970s, concern about the impact of oil spills on the aquatic environment heightened, and, consequently, there was great interest in evaluating the uptake and disposition of petroleum constituents, especially benzenes and polycyclic aromatic hydrocarbons (PAH) in fish and shellfish. Measurements of tissue concentrations of benzenes and PAH in fish sampled from oil-impacted areas or urban estuaries showed the presence of aromatic hydrocarbons with 1-3 benzenoid rings, such as derivatives of benzene, naphthalene (NPH), biphenyl, and phenanthrene (PHN), but rarely showed detectable levels of 4-ring to 6-ring PAH, such as benz(a)anthracene (BaA) or benzo(a)pyrene (BaP). Current interest in biotransformation and disposition of PAH in fish stems from two rather divergent perspectives: one is to evaluate the potential of food-chain transfer of toxic PAH and their metabolites, and the other is to evaluate mechanisms of toxicity of environmental pollutants in fish. In this chapter, endogenous and exogenous factors that affect metabolism and disposition of PAH in fish are discussed. Emphasis is placed on the disposition of phase I and phase II metabolites in various tissues and fluids, and the interactions of reactive intermediates with cellular macromolecules. (See also W89-11826) (Lantz-PTT)
W89-11830

ENZYMES INVOLVED IN METABOLISM OF PAH BY FISHES AND OTHER AQUATIC ANIMALS: OXIDATIVE ENZYMES (OR PHASE I ENZYMES).
Oregon State Univ., Corvallis. Toxicology Program.
D. R. Buhler, and D. E. Williams.
IN: Metabolism of Polycyclic Aromatic Hydrocarbons in the Aquatic Environment. CRC Press, Inc., Boca Raton, Florida. 1989. p 151-184, 5 tab, 228 ref. National Inst. of Environmental Health Sciences Grant Nos. ES0040, ES00210, and ES03850.

Descriptors: *Hydrocarbons, *Aquatic animals, *Path of pollutants, *Bioaccumulation, *Enzymes, *Biotransformation, *Polycyclic aromatic hydrocarbons, *Fish, *Fate of pollutants, Aquatic environment, Chemical reactions, Fish, Fish physiology, Organic compounds, Polychlorinated biphenyls, Bioaccumulation, Toxicity, Carcinogens, Oxygenation, Metabolites, Literature review.

Freshwater and coastal marine environments act as sinks for the deposition of numerous chemicals (xenobiotics) of natural and anthropogenic origin. Xenobiotics such as the polycyclic aromatic hydrocarbons (PAH) and the polychlorinated biphenyls (PCB) resist chemical and biological degradation, and tend to persist in the aquatic environment. Because of their high lipophilicity, such chemicals are readily bioaccumulated by aquatic organisms in proportion to their octanol:water partition coefficients. These lipophilic compounds are oxygenated by cytochromes P-450 to produce either detoxication metabolites, usually in conjunction with the phase II conjugation enzymes, or to activated electrophilic metabolites which can covalently react with macromolecules producing a variety of toxic effects, including carcinogenesis. Biotransformation reactions are usually classified into two categories, phase I and phase II reactions. Phase I reactions introduce polar groups into the xenobiotic molecule through oxidative, hydrolytic, or reductive processes. Phase II reactions involve conjugation of xenobiotics or their phase I metabolites with polar cellular constituents such as glucuronic acid, sulfate, or glutathione to form highly water soluble conjugates, easily excreted via bile, kidney, or gill. Although not as thoroughly studied as in mammals, the comparative metabolism of xenobiotics by fish and other aquatic animals has been the subject of several previous reviews. This chapter focuses primarily on the enzymes involved in the oxidative metabolism of PAH by fish, crustaceans, mollusks, and other aquatic animals. Special emphasis is given to the cytochrome P-450 dependent mixed-function oxidase (MFO) system. (See also W89-11826) (Lantz-PTT)
W89-11831

ENZYMES INVOLVED IN METABOLISM OF PAH BY FISHES AND OTHER AQUATIC ANIMALS: HYDROLYSIS AND CONJUGATION ENZYMES (OR PHASE II ENZYMES).
Oregon State Univ., Corvallis. Dept. of Biochemistry and Biophysics.
G. L. Foureman.
IN: Metabolism of Polycyclic Aromatic Hydrocarbons in the Aquatic Environment. CRC Press, Inc., Boca Raton, Florida. 1989. p 185-202, 5 tab, 128 ref. National Inst. of Environmental Health Sciences Grant ES 01978.

Descriptors: *Aquatic animals, *Fate of pollutants, *Hydrocarbons, *Enzymes, *Path of pollutants, *Polycyclic aromatic hydrocarbons, *Fish physiology, Aquatic environment, Hydrolysis, Literature review, Glucuronosyltransferase, Sulfotransferase, Metabolites, Conjugation, Biotransformation, Toxicity.

There are several recent reviews available on the enzymes involved in conjugation and hydrolysis of polycyclic aromatic hydrocarbon (PAH) metabolites and on xenobiotic metabolism in aquatic species. In combining these two concerns, this chapter emphasizes recent studies of these enzymes in aquatic species, wherein metabolites of PAH or closely related substrates were employed to show how the ability of an organism to metabolize PAH can be evaluated from a detailed consideration of activation and detoxication enzymes. The enzymes involved in this secondary metabolism include the glutathione S-transferases (GST), UDP-glucurono-

syltransferrases, and sulufotransferases. According to the classical definitions, these are phase II enzymes which function to increase the polarity of the lipophilic xenobiotic (phase I metabolites of PAH) by conjugating it with the endogenous compounds indicated in the names of the enzymes; this increase in polarity makes phase II metabolites more readily excreted by the organism. Although the other enzyme discussed in this chapter, epoxide hydrolase, is usually not considered to be a phase II enzyme, it does fit into the broad definition (water being quite endogenous), and it is therefore included. This review covers the literature from 1976 up to the summer of 1987. (See also W89-11826) (Lantz-PTT)
W89-11832

METABOLIC ACTIVATION OF PAH IN SUBCELLULAR FRACTIONS AND CELL CULTURES FROM AQUATIC AND TERRESTRIAL SPECIES.
National Marine Fisheries Service, Seattle, WA. Northwest and Alaska Fisheries Center.
U. Varanasi, M. Nishimoto, W. M. Baird, and T. A. Smolarek.
IN: Metabolism of Polycyclic Aromatic Hydrocarbons in the Aquatic Environment. CRC Press, Inc., Boca Raton, Florida. 1989. p 203-251, 12 fig, 5 tab, 149 ref. Public Health Service Grants CA40228 and CA28825.

Descriptors: *Hydrocarbons, *Path of pollutants, *Fate of pollutants, *Polycyclic aromatic hydrocarbons, *Biotransformation, Aquatic environment, Detoxification, Benz(a)pyrene, Fish, Mammals, Biological studies, Enzymes, Metabolism, Excretion, Oxidation.

Cellular metabolism of polycyclic aromatic hydrocarbons (PAH) results in the conversion of these hydrophobic compounds into forms that can be excreted from the cell and ultimately from the organism. One of the most widely studied PAH is benzo(a)pyrene (BaP), a common environmental contaminant found in food, air, and water. The general pathways of metabolism of BAP are illustrated. Initially, metabolism involves oxidation of the PAH that is usually catalyzed by the microsomal cytochrome P-450-dependent mixed function oxidases (MFO). In most cases, this results in the formation of an epoxide or arene oxide, although oxidation at specific positions probably occurs through other intermediates. The arene oxides can be formed at a number of positions and specific forms of cytochrome P-450 demonstrate stereoselectivity in the proportions of specific isomeric arene oxides formed. The arene oxides are relatively unstable metabolites that undergo three major reactions: (1) spontaneous rearrangement to form phenols; (2) hydration to form trans dihydroxydihydro compounds (diols), a reaction catalyzed by the enzyme epoxide hydrolase (EH); and (3) conjugation with glutathione (GSH) involving either catalysis by a family of glutathione-S-transferase (GST) enzymes, or by direct reaction at a slower rate. The GSH conjugates are water soluble precursors of mercapturic acids and are generally considered to be detoxication products. The formation of such reactive metabolites is generally detected in cells by analysis of the reaction products formed with cellular macromolecules such as protein, RNA, and DNA. Other unsubstituted PAH are metabolized by pathways similar to those for BaP. Most studies of PAH metabolism in aquatic organisms have been carried out with subcellular fractions. In this chapter, the metabolic activation of PAH by cellular fractions of marine and freshwater fish are compared with terrestrial organisms, mainly rodents. The data available on PAH metabolism in cell cultures prepared from fish are then compared with data obtained from mammalian cell cultures. (See also W89-11826) (Lantz-PTT)
W89-11833

HYDROCARBONS IN MARINE MOLLUSKS: BIOLOGICAL EFFECTS AND ECOLOGICAL CONSEQUENCES.
Marine Biological Association of the United Kingdom, Plymouth (England).
For primary bibliographic entry see Field 5C.
W89-11836

CAUSES AND CONSEQUENCES OF SURFACE WATER ACIDIFICATION,
Imperial Coll. of Science and Technology, London (England). Centre for Environmental Technology.
J. Mason.
IN: Acid Toxicity and Aquatic Animals. Cambridge University Press, Cambridge. 1989. p 1-12, 4 fig, 1 tab.

Descriptors: *Hydrocarbons, *Acid rain, *Water pollution effects, *Acidic water, *Air pollution, *Environmental effects, Scandinavia, Path of pollutants, Chemical reactions, Precipitation, Toxicity, Aquatic environment, Dry deposition, Snow, Chemistry of precipitation, Soil chemistry, Ecological effects.

Although the term acid rain is commonly used to describe all acid deposition from the atmosphere that may cause damage to trees, vegetation, fisheries, buildings, etc., in fact rain (and snow) brings down only about one third of the total acids over the UK, two thirds being deposited in the dry state as gases and small particles. But wet or dry, there is little doubt that acid deposition from the atmosphere poses an ecological threat, especially to aquatic life in streams and lakes on hard rocks and thin soils in southern Scandinavia and in some parts of Scotland and North America. A great deal of research is being undertaken in these three areas but this account is based largely on work in Scandinavia and the UK, where more than 30 research groups from a wide variety of disciplines and institutions are working in a closely integrated and coordinated program under the author's direction. This brief coverage of the relevant scientific problems includes studies of the transport and chemical transformations of emitted pollutants in the atmosphere; the wet and dry deposition of the resulting acids; the acidity and chemical composition of the rain and snow; modification of the chemistry of the rainwater as it percolates through and interacts with the soil and rocks; and the toxic effects of the modified water chemistry on aquatic biota in streams and lakes. (See also W89-11837) (Lantz-PTT)
W89-11838

NATURE AND EXTENT OF MARINE CONTAMINATION CAUSED BY LAND-BASED SOURCES IN CANADA,
Department of Fisheries and Oceans, Vancouver (British Columbia). West Vancouver Lab.
M. Waldichuk.
IN: Canadian Conference on Marine Environmental Quality: Proceedings, February 29-March 3, 1988, Halifax, Nova Scotia. The International Institute for Transportation and Ocean Policy Studies, 1236 Henry St., Halifax, Nova Scotia, Canada. 1988. p 75-135, 37 fig, 3 tab, 78 ref.

Descriptors: *Water pollution effects, *Marine environment, *Water pollution sources, *Canada, *Environmental effects, Coastal waters, Wastewater disposal, Urban runoff, Agricultural runoff, Shellfish, Public health, Pulp and paper industry, Industrial wastewater, Pesticides, Organic compounds, Atlantic Ocean, Pacific Ocean, Arctic Ocean.

A major adverse effect on utilization of marine living resources on the Atlantic and Pacific coasts of Canada stems from sewage and urban and agricultural runoff. Bacterial contamination of shellfish beds has a significant impact on the regional economies. In the Atlantic Maritimes during 1983, closures were in effect for 262 shellfish-growing areas, comprising 140,000 hectares (ha). On the Pacific coast, 55,000 ha of shellfish growing area, representing 690 km of coastline, were closed in 1986. On both coasts in summer, some beaches are posted by public health authorities as unsafe for bathing due to sewage pollution. Pulp and paper mill effluents constitute the principal industrial contaminant, with 20 mills on the Atlantic, excluding Quebec, and 11 on the Pacific coast. Degradation of benthic habitats by deposition of wood solids, and depletion of dissolved oxygen in receiving waters, by decomposition of dissolved organic constituents, may arise from marine disposal of such effluents. Mining, agriculture, food and beverage processing, pesticide application in forestry, lumber manufacture and agriculture, petroleum refineries, petrochemical industries, steel mills, chloralkali plants, electroplating works, smelters and other chemical operations contribute a proportion of chronic contamination in coastal waters of Pacific and Atlantic Canada. Toxic chemical spills cause transient hazards. In the Arctic, the main concern is potential contamination by oil during exploration for an exploitation of petroleum hydrocarbons in any environment where temperatures are low and elimination of hydrocarbons from an oil spill would be very slow. (See also W89-11852) (Author's abstract)
W89-11857

STRATEGIES FOR THE CONTROL OF LAND-BASED SOURCES OF MARINE POLLUTION IN THE UNITED STATES.
Office of Technology Assessment, Washington, DC.
For primary bibliographic entry see Field 5G.
W89-11859

OVERVIEW OF MARINE ENVIRONMENTAL QUALITY ISSUES ON THE ATLANTIC COAST OF CANADA,
Department of Fisheries and Oceans, Halifax (Nova Scotia). Halifax Fisheries Research Lab.
For primary bibliographic entry see Field 5C.
W89-11863

OVERVIEW OF MARINE ENVIRONMENTAL QUALITY IN THE CANADIAN ARCTIC,
Environmental Protection Service, Yellowknife (Northwest Territories).
For primary bibliographic entry see Field 4C.
W89-11865

ANALYSIS OF TRACE ORGANICS IN THE AQUATIC ENVIRONMENT.
For primary bibliographic entry see Field 5A.
W89-11868

ENVIRONMENTAL ASPECTS AND ANALYSIS OF PHENOLS IN THE AQUATIC ENVIRONMENT.
National Water Research Inst., Burlington (Ontario).
For primary bibliographic entry see Field 5A.
W89-11872

PHTHALATE ESTERS IN THE AQUATIC ENVIRONMENT.
National Water Research Inst., Burlington (Ontario).
For primary bibliographic entry see Field 5A.
W89-11875

HUMIC ACID AND RELATED SUBSTANCES IN THE ENVIRONMENT.
National Water Research Inst., Burlington (Ontario). Research and Applications Branch.
For primary bibliographic entry see Field 5A.
W89-11877

VOLATILE ORGANIC COMPOUNDS IN GROUNDWATER AND LEACHATE AT WISCONSIN LANDFILLS.
Wisconsin Dept. of Natural Resources, Madison. Bureau of Solid Waste Management.
M. A. Friedman.
Report No. PUBL-WR-192, February 1988. 79p, 9 fig, 11 tab, 6 ref, 7 append.

Descriptors: *Water pollution sources, *Water pollution prevention, *Volatile organic compounds, *Groundwater pollution, *Landfills, *Wisconsin, *Leachates, Monitoring, Lysimeters, Liners, Groundwater quality, Clay liners, Aeration zone, Waste disposal, Waste management, Design standards, Industrial wastes, Municipal wastes.

The Wisconsin Department of Natural Resources, Bureau of Solid Waste Management is evaluating

the need for periodic volatile organic compound (VOC) sampling at landfills. Department staff selected 26 landfills to sample based on design, age and performance. Nine clay-lined, six zone-of-saturation, six retarder or combined retarder and natural attenuation, four natural attenuation and one sludge-lined landfill were sampled. Samples from groundwater, leachate and collection lysimeters samples were analyzed for VOCs. VOCs were detected in groundwater at landfills of various ages, designs and locations. Three collection lysimeter samples contained VOCs, and were attributed to contamination from glues used in construction or sources other than leachate. Concentrations of VOCS in leachate were generally greater than in groundwater except in some highly contaminated wells. Groundwater containing VOCs frequently did not contain the same VOC parameters as leachate samples from the same landfill. VOCs were detected more frequently in groundwater samples at zone-of-saturation landfills, retarder or combined retarder and natural attenuation landfills, and natural attenuation landfills. Zone-of-saturation sites where VOCs were detected had areas that were not built to today's design standards. Most industrial waste leachates contained fewer VOC parameters and lower VOC concentrations than municipal landfills. The author recommends that the Bureau of Solid Waste should: (1) require periodic VOC monitoring of leachate and collection lysimeter samples; (2) require VOC monitoring at selected groundwater points at frequencies chosen on the basis of design, performance, the goal of the monitoring program and the need to confirm variable data; (3) conduct a study to develop a VOC monitoring strategy and action plan for industrial landfills and small municipal landfills by analyzing VOCs in groundwater and leachate; (4) develop guidelines for actions to take when low concentrations of VOCs are found in groundwater; and (5) follow up on statewide VOC surveys and VOC monitoring requirements in other states. (Lantz-PTT)
W89-11891

SHAD RETURN TO THE DELAWARE.
For primary bibliographic entry see Field 5G.
W89-11899

WHAT WE LEARNED FROM THE RHINE.
Fawcett Consultants, Inc., Wheaton, MD.
H. H. Fawcett.
IN: Hazardous and Toxic Materials: Safe Handling and Disposal. John Wiley and Sons, New York. 1988. p 421-428, 1 tab, 2 ref.

Descriptors: *Spills, *Water pollution sources, *Water pollution effects, *Industrial wastes, *Chemical industry, *Rhine River, Pesticides, Fisheries, Organic compounds, Mercury, Fungicides, Insecticides, Endosulfan, Agricultural chemicals, Ecological effects, Fishkill, Fish stocking, Groundwater pollution.

On November 1, 1986, at 00.19 hours, the fire alarm at the Sandoz facility at Schweizerhalle (near Basel on the Rhine) was raised almost simultaneously by a police patrol and Sandoz safety personnel. Warehouse 956 was already ablaze and the fire had spread so rapidly that the 10 fire brigades with 160 men were able to do little. Their attempts to extinguish the fire with foam were ineffective and water had to be used. The volume required proved too great for the capacity of the catch basins, or bund; as a result, several hundred thousand liters of this water drained into the nearby Rhine. Unfortunately, it was by then contaminated by the chemical and agrochemical substances that had been stored in the warehouse. Warehouse 995, at the time of the fire, contained about 1000 metric tons of agrochemical products and 300 tons of formulation auxiliaries and other chemicals, including: organophosphates/insecticides; urea derivative metoxuran; nitrocresol derivative DNOC; oxazolidin fungicide; organic mercury compounds (ethoxyethyl mercury hydroxide and phenyl mercury acetate); endosulfan; tetradifon; captafol; Zineb; Scillirosid; and zinc phosphate. These were of varying degrees of toxicity and were responsible for killing large numbers of fish in the Rhine. The most lethal substances involved were mercury compounds. In the Rhine, both its fauna and its flora have suffered over a length of about 250 km. On the other hand, the river's microbiota appears to have remained sufficiently intact to maintain its self-cleaning capacity, although it could be years before the water regains its prefire status. The values for noxious substances in the river are currently not elevated and the restrictions imposed on use of the water have now been lifted. Groundwater contamination was localized and only slight, and no further damage is expected on the basis of what is known about the geohydrological conditions. In addition to modified fire prevention plans, Sandoz is working with the fishing interests on the Upper Rhine to develop a restocking hatchery for young fish (Rhine trout), and with the Baden-Wurttemberg on its eel-restocking project. (See also W89-11898) (Lantz-PTT)
W89-11903

INTRODUCTION TO THE PRINCIPLES OF LAND APPLICATION OF SLUDGE.
Environmental Protection Agency, Washington, DC. Office of Solid Waste.
B. R. Weddle.
IN: Design Seminar Handout: Sludge Treatment and Disposal. Environmental Protection Agency Environmental Research Information Center Technology Transfer, 1977. p 195-209, 2 fig, 7 tab.

Descriptors: *Sludge disposal, *Land disposal, *Path of pollutants, *Sludge utilization, Cropland, Bioaccumulation, Nitrogen, Soil contamination, Heavy metals, Toxicity, Waste disposal, Cadmium.

Like landfilling, ocean dumping or any other disposition option, the landspreading of municipal sludge carries certain environmental risks. Sludge-borne metals such as zinc, copper, nickel, and lead, generally become toxic to plants before they reach levels that can be harmful to man. Cadmium, on the other hand, being less toxic to plants can reach potentially harmful levels to man within the crops. A 1974 study conducted by the US Food and Drug Administration indicates that the mean intake of cadmium from food and drinking water in the U.S. is approximately 72 micrograms/day--a tolerable daily intake level is 57 to 71 micrograms/day. The landfilling of sludge like the disposal of any waste material, carries with it the potential for environmental degradation. Therefore, in order to minimize such degradation, it is necessary to exercise the appropriate management control. Additional care should also be taken in the design and operation of any site which accepts municipal sludge. Specifically such sites should closely follow the guidance contained in EPA's publication 'Sanitary Landfill Design and Operation.' (Lantz-PTT)
W89-11913

PROCEEDINGS OF THE FOCUS CONFERENCE ON EASTERN REGIONAL GROUND WATER ISSUES.
For primary bibliographic entry see Field 2F.
W89-11916

GROUNDWATER MONITORING IN KARSTIC TERRAIN: A CASE STUDY OF A LANDFILL IN NORTHERN NEW YORK.
Stearns and Wheeler, Cazenovia, NY.
For primary bibliographic entry see Field 2F.
W89-11920

SURFACE WATER TRACER INVESTIGATION OF LEACHATE DISCHARGE FROM A NEW YORK CITY LANDFILL.
New York State Dept. of Environmental Conservation, New York.
D. C. Walsh, and S. R. Rives.
IN: Proceedings of the FOCUS Conference on Eastern Regional Ground Water Issues, September 27-29, 1988, Stamford, Connecticut. National Water Well Association, Dublin, Ohio, 1988. p 101-120, 11 fig, 1 tab, 12 ref.

Descriptors: *Leachates, *Path of pollutants, *Landfills, *Groundwater pollution, *Tracers, *Data acquisition, Dye releases, Surface water, Hazardous wastes, Tides, Jamaica Bay, Water pollution control, Fluorescence, Water circulation, Water sampling, Soil contamination, Network design, Synoptic analysis, Water pollution sources.

A surface water tracer study was performed in Jamaica Bay adjacent to a 110 acre Brooklyn, New York landfill to determine the local mixing pattern and assess the distribution of highly contaminated leachate seeping from a 500 ft length of landfill shoreline. The outbreak is discharging non-aqueous phase liquid and about 12,000 gallons per day (gpd) of associated leachate. Hazardous wastes were dumped illegally at the landfill during the 1970's and an estimated 15 million gallons of non-aqueous phase liquid are contained in landfill soils. Rhodamine WT dye was used as the water tracer. It was injected continuously for 5 days from a raft anchored in the area of the outbreak. Measurements of dye fluorescence in surface water were taken daily along selected transects throughout the bay. The configuration of the dye plume was mapped at different phases of the tidal cycle, with results showing that the surface water flow from the outbreak hugs the northern shoreline of Jamaica Bay. Due to the relatively rapid bay water dilution of landfill pollutant discharge that was predicted during the survey, most sampling stations for surface water and sediment should be positioned within 2,000 ft of the discharge location. Stations should be placed along the northern shoreline of the bay, east and west of the site. Sampling frequency should be greatest adjacent to the source and should decrease with distance from the site. The pronounced effect of tidal action on the distribution of the dye (leachate) plume necessitates consideration of the tidal phase and projected plume location prior to collection of surface water samples. Collection of samples from stations east of the landfill should be performed near the end of the flood tide. The most effective approach would be collection of 2-4 synoptic rounds of surface water samples from selected stations east and west of the landfill during different phases of the tidal cycle. (See also W89-11916) (Lantz-PTT)
W89-11922

PREDICTING AND TRACING LOW LEVEL VOLATILE CONTAMINANTS: A CASE STUDY.
Gerber (Robert G.), Inc., Freeport, ME.
A. L. Tolman.
IN: Proceedings of the FOCUS Conference on Eastern Regional Ground Water Issues, September 27-29, 1988, Stamford, Connecticut. National Water Well Association, Dublin, Ohio, 1988. p 121-134, 5 fig, 1 tab, 3 ref.

Descriptors: *Solvents, *Path of pollutants, *Volatile organic compounds, *Groundwater pollution, Water pollution control, Maine, Organic compounds, Trace levels, Case studies, Prediction, Geohydrology, Monitoring, Aquifers, Industrial development, Aeration zone, Cleanup, Observation wells, Water quality standards, Solvent management, Standby water treatment, Chlorinated hydrocarbons.

This report summarizes the results of a geohydrologic investigation of a known spill of 1,1,1-trichloroethane at a manufacturing plant site in southern Maine. The site is over a mapped sand and gravel aquifer. The area was selected as an industrial park site by the local development commission in the mid 1970s. At the time of selection, the area was recognized as an aquifer, and the availability of water for industry was one factor in its selection. Up to 55 gallons of 1,1,1-trichloroethane could have leaked, although the true amount was almost certainly much less. Since no concentrations of solvent were found in the unsaturated zone, there is little likelihood that the spill was large. Very low concentrations of 1,1,1-trichloroethane in near field wells confirm the small scale of the problem. There is little potential for groundwater cleanup. No spring pulse of 1,1,1-trichloroethane was detected in the near field wells this year (1988). Additional monthly monitoring is of limited utility. Given the information collected to date, it is recommended that the monitoring be

discontinued, or at most, include sampling after normal recharge seasons (ie., May or June and November or December). The Water District well samples show very low levels of 1,1,1-trichloroethane. These concentrations are < 1% of the EPA Maximum Contaminant level (Goal) for public water supplies. Given the location of the water supply wells, chronic low level VOC contamination appears inevitable. Rather than abandon the groundwater resource in this area, aggressive solvent management within the industrial park appears appropriate. It would also be prudent to have stand-by treatment capacity for this and other similarly situated wells. (See also W89-11916) (Lantz-PTT)
W89-11923

ETHYLENE THIOUREA IN MAINE GROUND WATER.
Maine Geological Survey, Augusta.
C. D. Neil, and J. S. Williams.
IN: Proceedings of the FOCUS Conference on Eastern Regional Ground Water Issues, September 27-29, 1988, Stamford, Connecticut. National Water Well Association, Dublin, Ohio, 1988. p 161-167, 2 tab, 12 ref.

Descriptors: *Path of pollutants, *Fate of pollutants, *Ethylene thiourea, *Groundwater pollution, *Pollutant identification, *Maine, *Pesticides, Fungicides, Agricultural chemicals, Groundwater quality, Wells, Chemical analysis, Urea pesticides.

Since 1986, the Maine Geological Survey has been analyzing groundwater for ethylene thiourea (ETU) in conjunction with Maine's Pesticide in Ground Water Study. ETU is a breakdown product of the fungicides maneb and mancozeb, the most widely used agricultural chemicals in Maine. Previous findings of ETU in groundwater are rare, but have been noted in California and in New Brunswick. Until 1987, the minimum statistically sound level of detection (MLD) for ETU was 60 parts per billion (ppb), while the maximum exposure guideline was 4.4 ppb. However, in 1987 new sampling and analytical methods developed by the US EPA lowered the MLD to 1 ppb, and a new Federal draft health advisory limit of 1 ppb was set. A maximum exposure guideline of 3 ppb, based on ETU's carcinogenic properties, was concurrently developed by the Maine Department of Human Services. To date, 40 wells located in or below potato fields in Aroostook County, Maine have been sampled for ETU. Eighteen of these wells have had detectable levels of ETU, with a maximum value of 23 ppb. Sixteen of the 19 wells (84%) which have been sampled and analyzed with the new methodology have had detectable levels of ETU. The wells in which ETU has been found are predominantly domestic wells drilled into bedrock. These findings have demonstrated the need for further studies on the extent and severity of ETU contamination in Maine groundwater. (See also W89-11916) (Author's abstract)
W89-11925

POTENTIAL NITRATE CONTAMINATION OF SHALLOW GROUND WATER FOLLOWING CHEMICAL REHABILITATION OF A SEPTIC SYSTEM.
Illinois Univ., Urbana. Dept. of Agronomy.
T. J. Bicki, and R. Bettler.
IN: Proceedings of the FOCUS Conference on Eastern Regional Ground Water Issues, September 27-29, 1988, Stamford, Connecticut. National Water Well Association, Dublin, Ohio, 1988. p 169-177, 4 fig, 19 ref.

Descriptors: *Soil disposal fields, *Water pollution treatment, *Path of pollutants, *Nitrates, *Groundwater pollution, Pollutant identification, Wastewater treatment, Fate of pollutants, Hydrogen peroxide, Soil contamination, Infiltration, Soil solution.

Soil solution samplers and shallow groundwater monitoring wells were utilized to monitor nitrate movement to groundwater following H2O2 application to a clogged soil absorption system. Nitrate-nitrogen concentrations in soil water and shallow groundwater ranged from 29 to 67 mg/L and 9 to 22 mg/L, respectively, prior to H2O2 treatment. Mean nitrate-nitrogen concentrations in soil water and groundwater increased and ranged from 67 to 115 mg/L and 23 to 37 mg/L, respectively, one week after H2O2 application. Elevated concentrations of nitrate-nitrogen above background persisted for several weeks following H2O2 treatment. The H2O2 treatment was unsuccessful in restoring the infiltrative capacity of a well structured soil. Application of H2O2 to the soil absorption system poses a threat of nitrate contamination of groundwater and its usefulness should be fully evaluated before rehabilitation is attempted. (See also W89-11916) (Author's abstract)
W89-11926

PREDICTING NITROGEN CONCENTRATIONS IN GROUND WATER-AN ANALYTICAL MODEL.
IEP, Inc., Sandwich, MA.
M. E. Nelson, S. W. Horsley, T. C. Cambareri, M. D. Giggey, and J. R. Pinnette.
IN: Proceedings of the FOCUS Conference on Eastern Regional Ground Water Issues, September 27-29, 1988, Stamford, Connecticut. National Water Well Association, Dublin, Ohio, 1988. p 179-202, 6 fig, 6 tab, 28 ref.

Descriptors: *Mathematical models, *Nitrates, *Nitrogen, *Groundwater pollution, *Path of pollutants, Pollutant identification, Chemical analysis, Model studies, Groundwater quality, Groundwater recharge, Social aspects, Fertilizers, Water resources development, Prediction, Regulations.

Nitrogen contamination of groundwater has resulted in the closure of water wells nationwide. Many communities, recognizing the relationship between land development and nitrogen contamination of groundwater, have developed regulations which require prediction of future nitrate-nitrogen concentrations which are likely to result from proposed developments prior to granting permits. Such regulations have included zoning bylaws, subdivision rules and regulations, and health regulations. A numerical solute transport model was used to calibrate nitrogen loading and recharge values related to residential land uses in unsewered areas. Nitrogen concentrations in two public supply wells were simulated over the last 25 years and loading values were altered until the simulated values matched with actual, measured values. The results of the modeling efforts allow the following conclusions to be made: (1) the sensitive inputs to the model were the loading from sewage and lawn fertilizers and the volume of stormwater recharged on site; (2) the loading from on site sewage disposal is controlled in a large part by occupancy--an increase from 2 to 3 people per household increases total on site nitrogen concentrations by 17.5%; (3) the loading parameters determined by the modeling effort can be used to determine the minimum lot size required to site a house with a septic system and maintain total expected nitrogen concentrations in groundwater recharge below 5 mg/L; and (4) variations in the recharge rates from both vegetated and impervious land areas would change the required minimum lot size. Disposing of stormwater off site through storm sewers would raise the necessary minimum lot size. The analytical model is most useful in predicting cumulative impacts from present and future development over a broad area. (Lantz-PTT)
W89-11927

NEW METHOD FOR FIELD ANALYSIS OF SOILS CONTAMINATED WITH AROMATIC HYDROCARBON COMPOUNDS,
Goldberg-Zoino and Associates, Inc., Vernon, CT.
For primary bibliographic entry see Field 5A.
W89-11930

MULTIOBJECTIVE ANALYSIS OF A COMPLEX AQUIFER SYSTEM CONTAMINATED WITH DENSE CHLORINATED HYDROCARBONS AND HEAVY METALS.
HMM Associates, Inc., Concord, MA.
J. W. Wood, D. L. Ellison, and C. G. Leszkiewicz.
IN: Proceedings of the FOCUS Conference on Eastern Regional Ground Water Issues, September 27-29, 1988, Stamford, Connecticut. National Water Well Association, Dublin, Ohio, 1988. p 275-299, 8 fig, 1 tab, 12 ref.

Descriptors: *Water pollution treatment, *Pollutant identification, *Heavy metals, *Path of pollutants, *Chlorinated hydrocarbons, *Groundwater pollution, Aquifers, Hydrocarbons, Groundwater recharge, Chromium, Iron, Sulfates, Model studies, Aquifer systems, Activated carbon, Industrial wastes.

A multiobjective analysis was conducted at the site of a defunct electronic circuit board manufacturing facility in Massachusetts. Disposal of untreated wastewater into leaching fields and leaks or spills of process wastes have resulted in groundwater contaminated with dense, chlorinated hydrocarbons and heavy metals. The objectives of the analysis were to: (1) identify the types of contaminants and source areas; (2) characterize the distribution of contaminants in the groundwater and identify pathways of migration; (3) evaluate groundwater recovery/recharge methods; (4) evaluate potential treatment units to remove contaminants from recovered groundwater; and (5) select the most cost effective remedial alternative based upon site-specific considerations. Aquifer characterization and restoration is complicated by the complex geohydrology of the site. A 3-D, multilayer, finite difference aquifer simulation model was developed to model recovery/recharge scenarios. Based upon modeling results and recognition of the probable behavior of the dense, chlorinated solvents, it was concluded that well point extraction would provide the most efficient method of recovering and controlling contaminated groundwater. Treatment of the groundwater was complicated by the presence of hexavalent chromium and background concentrations of iron and sulfates which have a detrimental effect on many treatment units. The variety of volatile organics present create an additional problem due to the wide range of Henry's Law constants and Freundlich isotherm values for adsorption. Finally, groundwater discharge permit requirements necessitate that effluent be treated to Safe Drinking Water Act maximum contaminant levels prior to aquifer recharge. The remedial solution selected for treatment of contaminated groundwater at this site included electrochemical reduction of chromate and precipitation of heavy metals followed by filtration and granular activated carbon to remove volatile organics. (See also W89-11916) (Author's abstract)
W89-11932

CREATION OF AN ARTIFICIALLY PRODUCED FRACTURE ZONE TO PREVENT CONTAMINATED GROUNDWATER MIGRATION.
Dunn Geoscience Corp., Albany, NY.
For primary bibliographic entry see Field 5G.
W89-11933

HIGHWAY DEICING SALT CONTAMINATION PROBLEMS AND SOLUTIONS IN MASSACHUSETTS.
Massachusetts Dept. of Public Works, Lexington. Research and Materials Section.
S. J. Pollock.
IN: Proceedings of the FOCUS Conference on Eastern Regional Ground Water Issues, September 27-29, 1988, Stamford, Connecticut. National Water Well Association, Dublin, Ohio, 1988. p 353-370, 5 fig, 1 tab, 3 ref.

Descriptors: *Deicers, *Water pollution control, *Highway effects, *Massachusetts, *Groundwater pollution, *Path of pollutants, Sodium, Wells, Costs, Economic aspects, Water pollution prevention, Water supply, Sodium chloride.

During the winters of 1974-75 through 1986-87, the Massachusetts Dept. of Public Works (MDPW) applied an average of 198,000 tons of sodium chloride on Massachusetts highways during winter snow and ice control operations, at an average rate of about 16.5 tons/lane mile/winter. This salt application caused sodium levels in groundwater and water supplies near highways, in some locations, to

increase significantly above the natural background level in this area of about 10 mg/L. During the period January 1982 through May 1988, the Massachusetts Dept. of Public Works received 139 complaints of salt contamination of private wells. These complaints were resolved by: (1) well replacement; (2) connection to public water supply; (3) water treatment; (4) highway drainage change; (5) use of salt substitute; and (6) complaint denied. During this period, the MDPW was provided with $2,500,000 by the state legislature, for investigation and remediation of salt contamination of water samples. In 1986, there were 73 public water supplies in Massachusetts with sodium levels above 20 mg/L. The increase, above background, of sodium in some of these water supplies was, at least partially, from the use of highway deicing salt. Complaints of salt contamination of public water supplies are resolved by: (1) reduced salting on state highways in the vicinity of the public water supply; (2) special attention given to salt handling and storage practices at maintenance facilities; (3) installation and operation of scavenger wells; (4) construction of special highway drainage systems to collect the highway runoff and carry it away from sensitive areas; and (5) complaint denied. (See also W89-11916) (Author's abstract)
W89-11937

TRANSPORT OF A NON-AQUEOUS PHASE LIQUID WITHIN A COMBINED PERCHED AND WATER TABLE AQUIFER SYSTEM.
Environmental Resources Management, Inc., Exton, PA.
T. F. Maguire.
IN: Proceedings of the FOCUS Conference on Eastern Regional Ground Water Issues, September 27-29, 1988, Stamford, Connecticut. National Water Well Association, Dublin, Ohio, 1988. p 539-558, 11 fig, 1 tab.

Descriptors: *Perched aquifers, *Unconfined aquifers, *Solute transport, *Groundwater pollution, *Groundwater movement, *Path of pollutants, Aquifers, Geohydrology, Groundwater budget, Cleanup operations, Oil spills, Permeability, Vertical flow, New Jersey.

A case study addresses the anomalous nature of free phase fuel oil migration within a glacial till sequence in northwestern New Jersey. The site-specific geohydrologic setting is characterized by a combined perched groundwater and water table aquifer system. The presence of a superpositioned saturated horizon has acted to significantly alter contaminant migration pathways as well as transport velocities. As a result of an underground storage tank failure, a significant volume of fuel oil was released to the subsurface. The presence of a low permeability horizon, partially encapsulating the tank pit, functioned to retain the majority of the non-aqueous phase liquid within the more permeable tank pit fill. Elevation fluctuations, due to precipitation events, within the perched groundwater system provided a mechanism for horizontal contaminant transport. As a result, lateral rather than vertical product migration predominated adjacent to the loss point. The configuration of the low permeability 'perching' strata in conjunction with the hydraulic gradient of the perched groundwater system functioned to distribute product in both up and downgradient directions relative to the underlying water table aquifer. Upon encountering monitoring well locations, the product was preferentially transported down the well bore/annulus, in response to a permeability gradient, subsequently accumulating on the water table. The presence of increased permeability conduits (monitoring wells), facilitated rapid vertical product transport through the perching horizon to the underlying water table aquifer. In addition, substantial artificial product accumulations, as great as 20 ft in thickness, were observed in the monitoring wells. Due to the isolated nature of free product accumulation on the water table as well as the presence of perched nonaqueous liquid, a portable rather than a centralized remedial system was deployed. The portable system accelerates site remedial activities while minimizing the adsorption and dispersion of contaminants within the subsurface, a common problem associated with a centralized recovery system. (Author's abstract)
W89-11946

GEOCHEMISTRY OF RADON-RICH WATERS FROM TWO-MICA GRANITES.
New Hampshire Univ., Durham.
For primary bibliographic entry see Field 2K.
W89-11949

HYDROGEOLOGIC AND SOIL GAS EVALUATION OF GROUNDWATER CONTAMINATION AT A MUNICIPAL LANDFILL IN NEW YORK STATE.
Dunn Geoscience Corp., Albany, NY.
T. V. Danahy, W. O. Howard, and D. J. Wolterding.
IN: Proceedings of the FOCUS Conference on Eastern Regional Ground Water Issues, September 27-29, 1988, Stamford, Connecticut. National Water Well Association, Dublin, Ohio, 1988. p 613-633, 9 fig, 3 tab, 30 ref.

Descriptors: *Geohydrology, *Groundwater pollution, *Landfills, *Path of pollutants, *Soil gases, New York, Chemical analysis, Monitoring, Aquifers, Glacial sediments, Bedrock, Pollutant identification, Organic compounds, Hydrocarbons, Iron, Manganese, Phenols, Benzene, Dichloroethane, Polychlorinated biphenyls, Volatile organic compounds, Soil contamination.

A geohydrologic study of municipal sanitary landfill located in east-central New York was performed under contract with the New York State Dept. of Environmental Conservation (NYSDEC). Project activities included a volatile organic soil gas survey using the Petrex Static Collection Technique, installation of six monitoring wells, surface and downhole geophysics, surface and groundwater sampling and geohydrologic interpretation. The soil gas survey identified downgradient areas of soil and/or groundwater contamination which were further investigated by the installation of monitoring wells. At the site the unconfined water table aquifer consists of fluvial, glaciodeltaic, and glaciolacustrine sediments. Groundwater flow is generally to the south in a semi-radial pattern at approximately 2 to 5 ft/day. The base of this primary water supply aquifer is defined by a leaky glacial till aquitard which occurs above the siltstone-shale bedrock aquifer. Reasonably good correlation exists between volatile organic soil gas mapping and groundwater contamination. Headspace analysis of pre-existing monitoring wells substantiated the migration and volatilization of organic compounds. Groundwater quality results include elevated levels of chlorinated hydrocarbon, aromatic hydrocarbon, metal and indicator parameters with respect to background conditions. Iron, manganese, phenol, benzene, 1,2-dichloroethane and two PCB compounds exceeded New York State groundwater standards or guidance values. Gas chromatography. mass spectrometry (MC/MS) and carbon-14 analyses indicate a significant amount of methane gas has been generated by landfilling activities. The soil gas survey proved to be a cost-effective diagnostic technique for preliminary evaluation of landfill generated volatile organic compounds. (See also W89-11916) (Author's abstract)
W89-11951

CONCEPTUAL MODEL OF NUTRIENT TRANSPORT IN SUBSURFACE SOIL SYSTEMS.
Maine Univ. at Orono. Environmental Studies Center.
M. W. Hall.
IN: Water Pollution Control in Low Density Areas: Proceedings of a Rural Environmental Engineering Conference, September 26-28, 1973, Warren, Vermont. University Press of New England, Hanover, New Hampshire, 1975. p 55-64, 2 fig, 3 tab, 22 ref.

Descriptors: *Fate of pollutants, *Septic tanks, *Path of pollutants, *Solute transport, *Nutrients, *Groundwater movement, Model studies, Phosphorus, Nitrogen, Fate of pollutants, Soil water.

An important question confronting those concerned with preserving the integrity of rural environments is the degree to which pollutants originating with septic tank systems may harm such environments. These are indications that such systems may be a significant source of the plant nutrients--nitrogen and phosphorus--entering surface waters. In isolated rural settings, where other large sources of these nutrients are not present, such effluents may very well contribute materially to the enrichment of surface waters. The fate of these nutrients after they leave the septic tank becomes, therefore, quite significant. There are several pathways by which effluents from soil systems might enter surface waters, including: (1) piping, through fractured rock or through eroded rock channels; (2) overland flow, resulting from clogging of the absorption field and the subsequent surfacing of the effluent; and (3) flow through porous media. Most of the nitrogen in septic tank effluent ultimately is converted to the nitrate form, which moves through soil water system with ease. Therefore, it is likely that most of the nitrogen introduced to soil systems by septic tanks will eventually enter ground or surface waters. Although most soils can retain large amounts of phosphorus, the system, like most such systems, can be overloaded either by applying too much phosphorus or by applying it too rapidly. Although soils clearly can 'fix' or immobilize, large amounts of phosphorus, there are several reasons to suspect that phosphorus also can be transported through soil systems. Much additional information on this subject is needed if ground and surface waters are to be protected against phosphorus pollution by septic tank effluents. Since nitrogen and phosphorus can be transported to some significant degree from one point to another within this system, thought should be given to development of a model which describes the rate and extent of this transport. Given certain information about effluent input and knowledge of these parameters, this model could be used to predict the concentration of some pollutant, in the aqueous phase, at some point in the system, as a function of time. (See also W89-11953) (Lantz-PTT)
W89-11958

GROUNDWATER POLLUTION--PROBLEMS AND SOLUTIONS.
National Water Well Association, Worthington, OH.
J. H. Lehr.
IN: Water Pollution Control in Low Density Areas: Proceedings of a Rural Environmental Engineering Conference, September 26-28, 1973, Warren, Vermont. University Press of New England, Hanover, New Hampshire, 1975. p 111-119, 7 ref.

Descriptors: *Groundwater pollution, *Water pollution sources, *Injection wells, *Solid wastes, *Aquifers, *Septic tanks, Waste disposal, Nitrates, Hydrocarbons, Organic compounds.

The major causes of groundwater pollution are: well injection; solid waste disposal; septic tank inadequacies; aquifer transfer; and chemical population. Deep well injection poses the greatest threat to our water supplies. The greatest danger comes when the well bore or the formation is plugged because of the: injection of fluid containing suspended solids; accumulation of corrosion products; precipitation of the injected fluid with the connate water of the formation; bacteriological plugging; swelling of mineral constituents. Solid waste disposal results in pollution originating from the leachates of from open dumps, solid waste composting sites, industrial refuse, and treatment plant sludge. But perhaps the worst of all are the antiseptically named but not so well operated 'sanitary landfills'. Septic tanks and other domestic waste disposal systems such as aerobic tanks can operate so as to pose no danger to the groundwater. To achieve such a compatible situation, soil conditions must be adequate, leach beds must be constructed with care, the water table must be a safe depth below the tank and leach bed, and water wells should be located beyond the area of influence of leachate movement. Aquifer pollution from interaquifer transfer through inadequate or abandoned wells is a problem for the groundwater geologist. To develop water from the highest quality aquifer

while sealing off those inadequate or poor quality, water well casings should be grouted into the ground and, under ideal conditions, screened only at the depth of the best aquifer. Additionally, states should enforce proper procedures for abandoning useless wells to that a rusted-out casing or open hole will not become a continuous avenue for aquifer transfer or surface water entry. Chemical pollution sources include petroleum contamination from leaking service station tanks and above-ground spills of gas and oil, agricultural feedlot pollution, salt thrown on icy winter roads which nearly all ends up in aquifers, and industrial wastes of wide varieties. Industrial and chemical wastes of the varieties cited may be a greater long term hazard than human waste. Micro-organisms from human waste can be effectively removed by filtration through only a short travel distance in granular earth material. Most chemical compounds, however, are carried without alteration or absorption through the groundwater system and into both ground and surface reservoirs. (See also W89-11053) (Lantz-PTT)
W89-11963

NITRATE CONTAMINATION OF THE WATER-TABLE AQUIFER BY SEPTIC TANK SYSTEMS IN THE COASTAL PLAIN OF DELAWARE.
Delaware Geological Survey, Newark.
J. C. Miller.
IN: Water Pollution Control in Low Density Areas: Proceedings of a Rural Environmental Engineering Conference, September 26-28, 1973, Warren, Vermont. University Press of New England, Hanover, New Hampshire, 1975. p 121-133, 6 fig, 10 ref.

Descriptors: *Nitrates, *Groundwater pollution, *Aquifers, *Septic tanks, *Water pollution sources, *Wastewater treatment, *Delaware, Coastal aquifers, Wells, Wastewater disposal.

Increased population growth in Delaware is resulting in a greater demand for potable water supplies. At present a large percentage of the public water supply is obtained from deep artesian aquifers. The water table aquifer is vulnerable to contamination by objectionable, possibly toxic fluids and water soluble solids placed on or within the soil. The permeability of the sands that compose the water table aquifer is such that contaminants can easily move toward public and private wells. If septic tank systems are used indiscriminantly around the edge of large cities in Delaware, the groundwater within the Pleistocene Columbia Formation, the water table aquifer, will be so contaminated by nitrates that it will not be suitable for use by the large communities as their water needs increase and wellfields move outward. In Dover, Delaware, where water levels in the Cheswold and Piney Point artesian aquifers are declining as a result of heavy pumpage in the Dover, Dover Air Force Base, and Cambridge, Maryland areas, the community will eventually have to resort to well fields in the Columbia Formation. Such a city as Dover will be surrounded by a ring of nitrate-contaminated water that it cannot use. It will then be necessary for the city to extend costly water lines out to uncontaminated areas. Water analyses on file at the Delaware Geological Survey revealed that 25% of the shallow wells (less than 50 ft deep) in the state yield water with nitrate levels above 20 ppm (parts per million). Although the U.S. Public Health Service upper limit for nitrate in drinking water is 45 ppm, the Delaware Geological Survey considers the 20 ppm level to be an indication of the beginning of nitrate contamination of the water table aquifer. These data support the long-held and little-applied belief that the use of septic tanks in high density suburban developments has detrimental effects on groundwater. (See also W89-11953) (Lantz-PTT)
W89-11964

VIRUS MOVEMENT INTO GROUNDWATER FROM SEPTIC TANK SYSTEMS.
Maine Univ., Orono. Dept. of Civil Engineering.
O. J. Sproul.
IN: Water Pollution Control in Low Density Areas: Proceedings of a Rural Environmental Engineering Conference, September 26-28, 1973, Warren, Vermont. University Press of New England, Hanover, New Hampshire, 1975. p 135-144, 4 tab, 18 ref.

Descriptors: *Viruses, *Groundwater pollution, *Septic tanks, *Fate of pollutants, Water pollution sources, Filtration, Path of pollutants, Adsorption, Biodegradation, Wastewater disposal.

Viruses can be recovered from any water that has been subjected to viral contamination. Little information is available on virus removal in septic tanks, however laboratory studies have shown minor removal of poliovirus type 1 after 3 hrs of sedimentation of domestic wastewater. Plant scale data show an inconsistent and undependable removal of viruses. In some cases, viruses increased in numbers after sedimentation, probably because of the breaking up of fecal material and liberation of the viruses to the bulk solution. Virus removal or inactivation in the soil after discharge from a septic tank may be affected by any or a combination of the following mechanisms: adsorption, bacterial enzymatic attack, and/or natural dieoff. Virus adsorption in the soil occurs in part because of an interaction between chemical groups on the virus protein coat and groups on the adsorbing surface. Field experience with relatively low application rates and low influent virus numbers but with viruses present after 5 ft of filtration, does not encourage confidence in the ability of the soil environment to reduce virus numbers to zero under marginal conditions. This is especially significant since these groundwaters are used for drinking water supplies without disinfection. Long filtration distances will affect virus removals. In a full-scale test by the swab-detection technique, no viruses could be found after filtration of a completely treated effluent through 200 ft of an 8 to 12 foot layer of sand and gravel. The test used 160,000 gallons of effluent containing 500 tissue culture infected dose units/ml of poliovirus type 3. (See also W89-11953) (Lantz-PTT)
W89-11965

THIRTY-FIVE YEARS OF USE OF A NATURAL SAND BED FOR POLISHING A SECONDARY-TREATED EFFLUENT.
Rensselaer Polytechnic Inst., Troy, NY. Dept. of Environmental Engineering.
For primary bibliographic entry see Field 5D.
W89-11972

NON-POINT POLLUTION SOURCES AND CONTROL.
Cornell Univ., Ithaca, NY. Environmental Studies Program.
R. C. Loehr.
IN: Water Pollution Control in Low Density Areas: Proceedings of a Rural Environmental Engineering Conference, September 26-28, 1973, Warren, Vermont. University Press of New England, Hanover, New Hampshire, 1975. p 269-299, 2 fig, 10 tab, 57 ref.

Descriptors: *Nonpoint pollution sources, *Water pollution control, *Water pollution sources, Surface runoff, Agricultural runoff, Precipitation, Urban runoff, Land management, Fertilizers, Water pollution prevention.

Interest in potential pollution sources other than municipal and industrial sources has increased as the nation has expanded its water pollution concerns and recognized that water, air, and land resources are not isolated components. Certain potential pollution sources such as precipitation, drainage from urban areas, runoff from forested and pasture lands, return irrigation flows, decaying vegetation, and wastes from wild animals generally have been assumed to be small compared to point sources such as municipal and industrial waste discharges. Based upon the reported range of characteristics in nonpoint sources and upon available technology for their control, the nonpoint sources were identified as follows: (1) uncontrollable or not needing control--precipitation, unmanaged forest land runoff, range land runoff; (2) possibly needing control--crop land runoff, runoff from land receiving manure, crop land tile drainage, irrigation return flows; and (3) requiring control--urban l and runoff, manure seepage, feedlot runoff. Many nonpoint sources will be difficult to control if control is defined as the ability to establish and enforce effluent standards for a given runoff event. However, if the control is approached by utilizing appropriate management practices, many of the sources are controllable. Proper land and crop management practices, such as erosion control, timing and integration of manure disposal practices on the land, and timing of fertilizer application to coincide closely with crop need offer opportunities to minimize runoff of potential pollutants from agricultural lands. (See also W89-11953) (Lantz-PTT)
W89-11974

WATER QUALITY IMPROVEMENT THROUGH CONTROL OF ROAD SURFACE RUNOFF.
Woodward-Clyde Consultants, San Francisco, CA. Envicon Div.
For primary bibliographic entry see Field 5G.
W89-11975

WATER POLLUTION AND ASSOCIATED EFFECTS FROM STREET SALTING.
Environmental Protection Agency, Edison, NJ. Storm and Combined Sewer Technology Branch.
R. Field, E. J. Struzeski, H. E. Masters, and A. N. Tafuri.
IN: Water Pollution Control in Low Density Areas: Proceedings of a Rural Environmental Engineering Conference, September 26-28, 1973, Warren, Vermont. University Press of New England, Hanover, New Hampshire, 1975. p 317-340, 7 fig, 8 tab, 75 ref.

Descriptors: *Water pollution sources, *Urban runoff, *Highway effects, *Deicers, *Path of pollutants, *Salts, *Ecological effects, Urban areas, Chlorides, Ice, Corrosion.

Salt contamination in runoff is generated by storm events. This report presents a state-of-the-art review of highway deicing practices and associated environmental effects and offers a summary of the available information on the following: (1) methods, equipment, and materials used for snow and ice removal; (2) chlorides found in rainfall and municipal sewage during the winter; (3) salt runoff from streets and highways; (4) deicing compounds found in surface streams, public water supplies, groundwater, farm ponds, and lakes; (5) special nutritious or toxic additives incorporated into deicing agents; (6) vehicular corrosion and deterioration of highway structures and pavements attributable to salting; and (7) effects of deicing compounds on roadside soils, vegetation, and trees. Some important conclusions drawn from this study are: (1) deicing salts are found in high concentrations in highway runoff. These salts have caused certain injury and damage across a wide environmental spectrum, and their potential dangers are severe; (2) practically all highway authorities in the US believe that 'bare pavement' conditions are necessary, and this attitude often results in excessive salt application; (3) salt storage sites are persistent and frequent sources of ground and surface water contamination and of vegetation damage; (4) the special additive in road deicers have latent toxic properties and are therefore particularly dangerous; (5) deicing salts have raised the chloride content of water supplies and receiving waters to dangerous levels; (6) deicing salts are a major factor in vehicular corrosion and roadway damage. Rust-inhibiting additives are not effective; and (7) road deicers can disturb soils, trees, and other vegetation comprising the roadside environment. The US Environmental Protection Agency is currently investigating proposals for further research in the area, and has already begun a large project which will produce two manuals--one a deicer user's manual, and the other a manual of design and recommended practices for storage facilities and methods of handling deicing materials throughout storage. (See also W89-11953) (Lantz-PTT)
W89-11976

LIVESTOCK GRAZING--A NONPOINT SOURCE OF WATER POLLUTION IN RURAL AREAS.
Utah State Univ., Logan. Dept. of Range Science and Ecology Center.
G. B. Coltharp, and L. A. Darling.
IN: Water Pollution Control in Low Density Areas: Proceedings of a Rural Environmental Engineering Conference, September 26-28, 1973, Warren, Vermont. University Press of New England, Hanover, New Hampshire, 1975. p 341-358, 8 fig, 2 tab, 26 ref.

Descriptors: *Livestock, *Nonpoint pollution sources, *Rural areas, *Water pollution sources, Coliforms, Bacteria, Public health, Logan River, Utah.

It has been estimated that grazed areas (pasture, grassland, and range) constitute over one third of the land area of the conterminous 48 states, and forested areas, which are grazed in many instances, constitute an additional one third of this land area. In order to ascertain the relative contribution of wildland grazing to rural water quality, selected water quality parameters were investigated on three small watersheds within the Logan River drainage of northern Utah during 1971 and 1972. Cattle and sheep grazing on small mountain watersheds with live streams significantly increases the total coliform, fecal coliform, and fecal streptococcus counts in the streams immediately below grazed areas. These indicator organisms were present at all downstream sampling stations (nonspring areas) regardless of the presence or absence of grazing livestock, but they were much more numerous in the streams draining grazed areas. If the number of bacteriological indicator organisms present in water is an accurate indication of actual pathogen presence, then cattle and sheep grazing a watershed through which streams flow can increase the potential health hazards of that stream to downstream users. However, the elevated counts measured in this study, which were attributable to grazing, did not persist after mixing with Logan River. Total coliform counts were generally < 100/100 ml in Logan River below the study watersheds, and fecal coliforms ranged from 5 to 50/100 mg. Also, livestock grazing had no apparent effects on the chemical and physical values measured in this study. Several of the parameters were slightly elevated during the grazing period, but in most instances they were not significantly different from the values before and after grazing. (See also W89-11953) (Lantz-PTT)
W89-11977

HYDROGEOLOGIC MISINTERPRETATIONS AND AQUIFER CONTAMINATION CAUSED BY LEAKING MONITORING WELLS.
Brown (K.W.) and Associates, Inc., College Station, TX.
For primary bibliographic entry see Field 7A.
W89-12003

CAPTURE OF A GROUNDWATER CONTAMINATION PLUME IN FRACTURED BEDROCK BY AN ARTIFICIALLY PRODUCED FRACTURE ZONE CREATED THROUGH CONTROLLED BLASTING.
Dunn Geoscience Corp., Albany, NY.
For primary bibliographic entry see Field 5G.
W89-12005

SIMULATION OF GROUNDWATER FLOW CHARACTERISTICS BY FLOW AND MASS TRANSPORT MODELS.
New Jersey Dept. of Environmental Protection, Trenton. Div. of Solid Waste Management.
For primary bibliographic entry see Field 5G.
W89-12006

ISOLATION AND MITIGATION OF GROUNDWATER CONTAMINATION BASED ON GROUNDWATER MODELING TECHNIQUES: A CASE HISTORY.
Camp, Dresser and McKee, Inc., Atlanta, GA.
For primary bibliographic entry see Field 5G.
W89-12007

CONTROL AND REMEDIATION OF VOLATILE ORGANIC CHEMICAL MIGRATION IN FRACTURED BEDROCK.
Jordan (Edward C.) Co., Inc., Portland, ME.
R. L. Fortin.
IN: HWHM 88: Hazardous Wastes and Hazardous Materials. Proceedings of the 5th National Conference held April 19-21, 1988, Las Vegas, Nevada. 1988. p 29-33, 7 fig, 1 ref.

Descriptors: *Path of pollutants, *Water pollution control, *Volatile organic compounds, *Groundwater pollution, Water pollution prevention, Geologic fractures, Geohydrology, Aquifers, Model studies, Groundwater recharge, Bedrock.

In many industrial and urban areas of the northeastern United States, volatile organic chemicals (VOCs) have been discharged into the ground, contaminating both soil and bedrock aquifers. Restoration of these aquifers can be a long and difficult task, depending on the physical setting and chemical distribution in the natural system. At one site in the northeast, a geohydrologic investigation was conducted to identify the principal migration and pathway(s) in the bedrock aquifer. A groundwater pumping test and pilot treatability test were completed for the design of a groundwater extraction and treatment system. The geohydrologic and chemical data were used to calibrate a two-dimensional finite difference flow and chemical transport model. The bedrock aquifer was modeled assuming porous media flow conditions (an 'equivalent porous medium'). The model was used to evaluate various pumping and injection schemes. Based on the modeling evaluation, a pumping system consisting of three wells strategically placed along a bedrock fracture zone was found to be the most effective remedial alternative for VOC contamination. This alternative was designed and implemented about 1.5 years ago. Data collected to date show that the total yield of the wells ranges from 10 to 15 gal/min and the capture zone extends beyond the VOC plume boundary. The capture zone and pumping rate appear to fluctuate seasonally with recharge, showing the need to closely monitor and regulate total pumping to maintain adequate control over plume migration and the recovery process. (See also W89-12002) (Lantz-PTT)
W89-12008

CASE HISTORY OF A CONTAMINATED GROUNDWATER DISCHARGE TO SURFACE WATER PURSUANT TO AN ACL.
Eder Associates, Locust Valley, NY.
For primary bibliographic entry see Field 5G.
W89-12010

BASICS OF GROUNDWATER CONTAMINATION MODELING.
Camp, Dresser and McKee, Inc., Atlanta, GA.
R. C. Johnson.
IN: HWHM 88: Hazardous Wastes and Hazardous Materials. Proceedings of the 5th National Conference held April 19-21, 1988, Las Vegas, Nevada. 1988. p 45-47.

Descriptors: *Water pollution prevention, *Groundwater pollution, *Model studies, *Path of pollutants, Regulations, Simulation analysis, Cleanup operations, Standards.

Successful groundwater protection programs or contamination remediation efforts depend primarily on complete understanding of groundwater flow and the associated movement of contaminant plumes. Once significant amounts of pollutants enter the groundwater system, recovery of the raw pollutant and treatment of contaminated groundwater are extremely costly operations. Complete cleanup of groundwater is usually impossible with available technology. Protection of vital, potable groundwater supplies must therefore be based on prevention by regulation of the potential sources of pollution. These regulations can take the form of land use controls, underground storage tank or pipeline construction standards, or groundwater monitoring requirements. However, all such regulations must be based on realistic evaluation of potential groundwater contamination impacts and/or risk assessments. Pollutant transport modeling provides the necessary technical basis for the evaluation of potential impacts from groundwater contamination. These techniques can also be used to understand and evaluate existing contamination problems and pollutant plume movement. Once understood, transport modeling helps to evaluate plume remediation alternatives. (See also W89-12002) (Lantz-PTT)
W89-12011

FIELD INVESTIGATION OF MACROFEATURES IN COMPACTED SOIL.
Brown (K.W.) and Associates, Inc., College Station, TX.
R. C. Speake, R. L. Shiver, D. C. Anderson, and J. A. Rehage.
IN: HWHM 88: Hazardous Wastes and Hazardous Materials. Proceedings of the 5th National Conference held April 19-21, 1988, Las Vegas, Nevada. 1988. p 187-191, 7 fig, 3 tab, 9 ref.

Descriptors: *Linings, *Waste disposal sites, *Field tests, *Geohydrology, *Compacted soils, *Soil properties, Dye releases, Tracers, Hydraulic conductivity, Soil water, Groundwater movement, Path of pollutants.

A method for delineating fluid conducting macrofeatures in compacted soil liners for surface impoundments through the use of a dye/chemical tracer and the results of an application of the method to a field problem are presented. Dye/chemical tracers effectively defined zones of high hydraulic conductivity resulting from poor construction practices utilized at the facility. Poor compaction techniques are cited in an explanation of the existence of dye-stained interlift areas of a compacted soil cover. Additionally, dye-stained roots, rocks, desiccation cracks and clod remnants are blamed for the rapid drainage of two of the four infiltration apparati. Because of its simplicity, the method is well-suited to the identification of zones of high hydraulic conductivity that may give rise to a compromise of the integrity of a liner system. To minimize seepage and/or transport of hazardous constituents from a containment structure, it is recommended that exceptionally good construction quality assurance be exercised when constructing compacted soil liners. (See also W89-12002) (Author's abstract)
W89-12026

CONTAMINATION ASSESSMENT AND REMEDIAL ALTERNATIVES FOR FORMER WASTE OIL PROCESSING FACILITY CONTAMINATING THE BISCAYNE AQUIFER.
Ecology and Environment, Inc., Tallahassee, FL.
For primary bibliographic entry see Field 5G.
W89-12039

STRATEGIES FOR EXTERNAL LEAD DETECTION OF UNDERGROUND STORAGE TANKS.
Environmental Monitoring and Support Lab., Las Vegas, NV.
For primary bibliographic entry see Field 7A.
W89-12047

MULTIPATHWAY RISK ASSESSMENT METHODOLOGY COMPATIBLE WITH CALIFORNIA DECISION TREE AND U.S. EPA SUPERFUND GUIDELINES.
ENVIRON Corp., Washington, DC.
For primary bibliographic entry see Field 5G.
W89-12051

STATISTICAL MODEL FOR DISTRIBUTION OF CHEMICALS IN GROUNDWATER,
Woodward-Clyde Consultants, Denver, CO.
V. Ekambaram, R. H. Montgomery, J. R. Doyle, and R. Swaroop.
IN: HWHM 88: Hazardous Wastes and Hazardous Materials. Proceedings of the 5th National Conference held April 19-21, 1988, Las Vegas, Nevada. 1988. p 418-423, 3 fig, 10 tab, 7 ref.

Descriptors: *Path of pollutants, *Model studies, *Groundwater pollution, *Statistical models, Hydrocarbons, Wells, Chemical analysis, Statistical analysis.

A statistical model was developed to describe groundwater contamination as a function of distance from the source area at a CERCLA site. Analytical data from over 200 monitoring and private wells were analyzed for carcinogenic polynuclear aromatic hydrocarbons (PNA). The wells were classified first into shallow, intermediate and deep depending on depth to groundwater intake. The shallow wells then were grouped based on location, water quality characteristics, concentration values were transformed (national logarithm) to approximate normal distributions. A principal component analysis was applied to the natural logarithm--transformed concentration data. A principal component value (F) associated with the median and the 90th percentile value for each group of wells was calculated and used as an independent variable that provides a representation of carcinogenic PNA contamination level for this group of wells. If one can predict the rate of contaminant migration, this model can be used to estimate contamination levels at any given location with time. Levels of contamination also can be evaluated for different treatment scenarios. (See also W89-12002) (Author's abstract)
W89-12059

USE OF AN INSTRUMENTED CONE PENETROMETER IN MONITORING LAND DISPOSAL SITES.
Army Engineer Waterways Experiment Station, Vicksburg, MS.
S. S. Cooper, R. G. Malone, R. S. Olsen, and G. B. Mohrman.
IN: HWHM 88: Hazardous Wastes and Hazardous Materials. Proceedings of the 5th National Conference held April 19-21, 1988, Las Vegas, Nevada. 1988. p 424-427, 5 fig, 2 tab, 3 ref.

Descriptors: *Soil characteristics, *Measuring instruments, *Soil contamination, Soil properties, Resistivity, Hydrogen ion concentration, Soil physical properties, Wastewater disposal.

The areal extent and depth of soil contamination at land disposal sites have typically been determined by collecting soil samples and conducting analyses for suspected contaminants. A soil probe, similar in basic design to equipment used for foundation investigations, has been modified to permit the in situ characterization of soils on the basis of grain size and the location of soil contamination by measuring soil resistivity. In field trials the modified soil probe has been effective in tracing soil types and determining the extent of soil contamination near a closed wastewater evaporation pond. The comparison of data indicates: soil strength measurements made with the probe can be used to infer major changes in soil type in the subsurface; soil resistivity measurements made in situ show trends that reflect the laboratory-based soil resistivity measurements; soil pH measurements generally increase with decreasing soil resistivity indicating alkaline soil contamination is being tracked; and the instrumented soil probe provides a rapid method for locating soil zones of anomalous resistivity and of locating major changes in soil type rapidly with the minimum problems of instrument decontamination. No samples are needed and therefore sample disposal and site cleanup are not needed. (See also W89-12002) (Lantz-PTT)
W89-12060

APPLICATIONS OF FIELD HEADSPACE ANALYSIS AND SOIL GAS ANALYSIS USING AN ORGANIC VAPOR METER TO ASSIST IN IDENTIFYING LABORATORY SAMPLE LOCATIONS.
Storch Engineers, Florham Park, NJ.
D. A. Jermakian, and C. J. Majka.
IN: HWHM 88: Hazardous Wastes and Hazardous Materials. Proceedings of the 5th National Conference held April 19-21, 1988, Las Vegas, Nevada. 1988. p 434-437, 2 fig.

Descriptors: *Path of pollutants, *Field tests, *Soil gases, *Measuring instruments, Organic vapor meter, Soil properties, Temperature, Organic soils, Hydrogen ion concentration, Underground storage, Groundwater pollution.

Collection of environmental samples for laboratory analysis during investigations of potentially contaminated sites is expensive. There is a need for a method of site screening which provides results that can be used in assessing the area tested, is cheaper than collecting and analyzing in a laboratory a large number of samples for a variety of parameters, and is more reliable than simple screening with an Organic Vapor Meter. Two methods, Field Headspace Analysis (FHA) and Soil Gas Analysis (SGA) have been used successfully for accurate site screening. Applications include initial site screening activities, location and delineation of contaminant plumes, testing soil around underground storage tanks and sampling along underground conduits. Both methods are easily learned and performed. Apart from an Organic Vapor Meter, FHA can be performed with equipment available in a local hardware store. Equipment for SGA is somewhat more elaborate and more expensive. Some limitations to these field methods exist. Cold temperatures, rain and snow can cause inaccuracies and problems with an organic vapor meter. High organic content in the soil and alkaline or acid soil can give false positives or false negatives. Many compounds that may be of concern are not detected with an organic vapor meter. (See also W89-12002) (Lantz-PTT)
W89-12061

MODELING OF CONTAMINANT TRANSPORT FROM RESERVE PIT SITES.
ERT, A Resource Engineering Co., Concord, MA.
A. B. Clark, and D. P. Galya.
IN: HWHM 88: Hazardous Wastes and Hazardous Materials. Proceedings of the 5th National Conference held April 19-21, 1988, Las Vegas, Nevada. 1988. p 473-477, 6 tab, 28 ref.

Descriptors: *Path of pollutants, *Model studies, *Drilling fluids, *Groundwater pollution, Simulation analysis, Leaching, Hydraulic conductivity, Benzene, Arsenic, Strontium, Nickel, Solute transport.

A by-product of oil drilling activities is drilling mud which contains quantities of metals and organic contaminants. This mud typically is pumped into and stored in a reserve pit adjacent to the drilling site. A study involved deterministic modeling to evaluate the groundwater quality impacts of 10 representative reserve pits in eight states. Data from column studies which simulated contaminants leaching through representative reserve pits were used to develop regression equations for contaminant mass fluxes of the leachate correlated against contaminant concentrations in the pit solid and hydraulic conductivity of the pit solid (or the clay filter cake, if present). Five compounds, including benzene, chloride, arsenic, strontium and nickel were modeled. Contaminant mass flux rates for three sites were calculated directly from the columns designed to represent these three sites. For another seven sites, contaminant mass flux rates were obtained via the regression equations. Contaminant mass flux rates were used as source terms to predict contaminant concentrations downgradient of the 10 representative reserve pit sites. The results of the modeling show no evidence of potential for contamination of groundwater from the 10 reserve pits studied. Predicted concentrations at receptor locations were found to not exceed the health-based water quality standards chosen for this evaluation. Therefore, the results indicate that these 10 reserve pits are not likely to contaminate groundwater resources. (See also W89-12002) (Lantz-PTT)
W89-12067

RECOVERY OF DNAPL--THEORY AND PRACTICE.
Union Carbide Corp., South Charleston, WV.
For primary bibliographic entry see Field 5G.
W89-12070

EVALUATION OF THE STANDARD ELUTRIATE TEST AS AN ESTIMATOR OF CONTAMINANT RELEASE AT THE POINT OF DREDGING,
Virginia Polytechnic Inst. and State Univ., Blacksburg.
For primary bibliographic entry see Field 5A.
W89-12075

INSTALLATION RESTORATION PROGRAM PHASE II: CONFIRMATION/QUANTIFICATION, STAGE I.
Ecology and Environment, Inc., Lancaster, NY. Buffalo Corporate Center.
Available from the National Technical Information Service, Springfield, VA 22161, as Ad-A197 892. Price codes: A06 in paper copy, A01 in microfiche. Final Report, April 1988. 180p, 27 fig, 39 tab, 14 append. USAF Contract F33615-83-D-4003.

Descriptors: *Cleanup operations, *Water pollution sources, *Path of pollutants, Pollutant identification, Reese Air Force Base, Texas, Geophysics, Soil contamination, Heavy metals, Lead, Nickel, Arsenic, Zinc, Chromium, Copper, Industrial wastewater.

A field investigation was conducted from June 24, 1986 to October 31, 1986, at nine areas at Reese Air Force Base, Lubbock, Texas. The investigation included records searches, geophysical studies, and sampling of surface and subsurface soils, groundwater and surface water. Samples were analyzed for various parameters including volatile organics, oil and grease, pesticides, herbicides, petroleum hydrocarbons, primary metals, phenols, polychlorinated biphenyls, and polynuclear aromatic hydrocarbons. Results of soil analysis from the areas checked reveal the main soil contaminants to be oil, grease, and metals. Analysis of soil samples indicated a wide range of oil and grease levels with the maximum concentration being 4,500 mg/kg. Lead, chromium, zinc, copper, nickel, and arsenic were found in various soil samples from the areas checked. No correlation was determined between the depth from which the samples were collected and the associated metal concentrations. Results of sediment analysis from the areas checked reveal the main sediment contaminants to be oil, grease, lead, and chromium. The maximum concentrations of oil and grease were found in sediments from the Industrial Waste Lake. The maximum oil and grease concentration was 12,000 mg/kg. The sediments from the Industrial Waste Lake also contained quantifiable concentrations of volatile organic compounds and phthalates. Lead and chromium were found in sediment samples from the Sewage Lake and the Drainage Impoundment. Follow-up studies have been recommended at most of the sites to better define the extent of contamination. (Lantz-PTT)
W89-12093

ESTIMATE OF THE OCCURRENCE AND DISTRIBUTION OF TOXICANTS IN STREAMBED SEDIMENTS OF THE SUSQUEHANNA RIVER SYSTEM.
Susquehanna River Basin Commission, Harrisburg, PA.
A. N. Ott, C. S. Takita, and S. W. Bollinger.
Susquehanna River Basin Commission Publication No. 123, February 1989. 21p, 1 fig, 6 tab, 9 ref, append.

Descriptors: *Priority pollutants, *Metals, *Bioassay, *Path of pollutants, *Sediment contamination, *Streambeds, *Susquehanna River, Organic compounds, Heavy metals, Lead, Arsenic, Mercury, Distribution patterns, River basins, Pesticides, Polychlorinated biphenyls.

Streambed sediment from 12 of 24 riverine sampling sites in the Susquehanna River basin showed some degree of contamination, either by detection of organic priority pollutants, high concentrations of metals or the presence of some toxicant as indicated by the Microtox bioassay. There was little correlation between the chemical detection of priority pollutants and the toxic response by the Microtox bacteria to sediment extracts. There appeared to be a major decrease in the content of organochlorine insecticides and polychlorinated bi-

phenyls in the bed sediments from 1974 to 1988. The concentration of extractable metals in the 1988 bed sediment samples were normally higher than the concentrations found in the 1974 samples. This is most likely due to the fact that the 1988 samples averaged more than twice the silt and clay content found in the 1974 samples. The one notable exception--one which was anticipated because of the reduction in use of leaded gasoline--was a reduction in lead (Pb) content. The mean concentration in 1974 was 123 mg/kg and decreased to a mean concentration of 76 mg/kg in 1988. The mean concentration for arsenic and mercury were approximately the same, however, maximum concentrations for both were higher in 1988. (Lantz-PTT)
W89-12101

WATER QUALITY OF INTERSTATE STREAMS IN THE SUSQUEHANNA RIVER BASIN MONITORING REPORT 2: WATER YEAR 1988 (OCTOBER 1987-SEPTEMBER 1988).
Susquehanna River Basin Commission, Harrisburg, PA.
C. P. McMorran, and S. W. Bollinger.
Susquehanna River Basin Commission Publication No. 122, May 1989. 113p, 7 fig, 39 tab, 2 ref, 2 append.

Descriptors: *Interstate rivers, *Water quality control, *Monitoring, *Susquehanna River, Water sampling, Water quality management, Iron, Manganese, Coliforms, Bacteria, Chemung River, Conowingo Creek, Octoraro Creek, Deer Creek, Scott Creek, Municipal wastewater.

A twelve station water quality monitoring network was conducted on interstate streams in the Susquehanna River Basin in November 1987, and February, May and August 1988. This was a continuation of a program begun in 1986. Twenty-four stations on other interstate streams were sampled in July and August 1988. Stream quality was also assessed by sampling benthic macroinvertebrates at each station in July and August 1988. This program contributes to a database that is used: (1) to assess compliance with water quality standards; (2) to assess impacts on water quality; (3) to characterize ambient and seasonal stream quality; and (4) for future trend assessment. Most interstate streams have good water quality. Only 46 out of 2,804 observations exceeded water quality standards. Iron and manganese most commonly exceeded standards. Fecal coliform counts were high in the Susquehanna River, Chemung River, Conowingo Creek, Octoraro Creek and Deer Creek. Scott Creek is severely degraded by domestic sewage and the pollutants from unknown sources in Delta, Pennsylvania and/or Cardiff, Maryland. (Author's abstract)
W89-12102

PRELIMINARY ANALYSIS OF NUTRIENT MONITORING DATA FOR THE SUSQUEHANNA RIVER AND SELECTED TRIBUTARIES: JANUARY 1, 1985-DECEMBER 31, 1987.
Susquehanna River Basin Commission, Harrisburg, PA.
For primary bibliographic entry see Field 2E.
W89-12104

SUMMARY OF SELECTED DATA ON CHEMICAL CONTAMINANTS IN TISSUES COLLECTED DURING 1984, 1985, AND 1986.
National Ocean Service, Rockville, MD. Office of Oceanography and Marine Assessment.
Available from the National Technical Information Service, Springfield, VA 22161, as PB88-100812. Price codes: A06 in paper copy, A01 in microfiche. NOAA Technical Memorandum NOS OMA 38, December 1987. 103p, 13 tab, 4 ref, 5 append.

Descriptors: *Data collections, *Tissue analysis, *Path of pollutants, *Mollusks, *Fish, *Polychlorinated biphenyls, DDT, Pesticides, Arsenic, Cadmium, Chromium, Lead, Mercury, Nickel, Silver, Tin, Liver, Antimony, Thallium, Heavy metals.

The most contaminated sites in the nationwide grid of the National Status and Trends Program have been identified on the basis of rankings of contaminant concentrations in bivalves at 145 Mussel Watch Project sites and in livers from fish at 43 Benthic Surveillance Project sites. The chemicals used on this national scale to define contamination were total polyaromatic hydrocarbons, total polychlorinated biphenyls, total DDT, total (non-DDT) chlorinated pesticides, and the elements, arsenic, cadmium, chromium, lead, mercury, nickel, silver and tin. The elements copper and zinc could not be used because their concentrations in bivalve tissue were so obviously determined by the species of bivalve. Selenium was not used because its concentration in bivalves varied over a very small range. Concentrations of antimony and thallium in bivalves and fish livers were so often below detectable levels that they could not be used on a national scale to define contamination. To a large extent the sites found to be among the 10% most contaminated sites were near large coastal cities. However, there are sites near these large cities that are not among the most contaminated and there are sites in apparently remote locations that are highly contaminated. Understanding both of those kinds of observations will require detailed analysis of the local situations. Differences in organic contaminant concentrations found in fish livers in 1984 and 1985 were generally small and indicate little short term temporal variability in contamination. (Author's abstract)
W89-12105

1987 ANNUAL SITE ENVIRONMENTAL REPORT FOR ARGONNE NATIONAL LABORATORY.
Argonne National Lab., IL. Environment, Safety and Health Dept.
N. W. Golchert, and T. L. Duffy.
Available from the National Technical Information Service, Springfield, VA 22161, as DE88-011771. Price codes: A06 in paper copy, A01 in microfiche. Report No. ANL-88-13, April 1988. 111p, 8 fig, 42 tab, 29 ref.

Descriptors: *Environmental impact statement, *Path of pollutants, *Radioactive wastes, *Industrial wastewater, *Water pollution effects, *Argonne National Laboratory, Tritium, Strontium, Cesium, Neptunium, Plutonium, Americium, Radioactivity, Sawmill Creek, Illinois River, Des Plaines River.

To evaluate the effect of Argonne National Laboratory (ANL) operations on the environment, sample collections were made on the site, at the site boundary, and off the ANL site for comparison purposes. Measurements were made for a variety of radionuclides in air, surface water, groundwater, soil, grass, bottom sediment, and milk. Samples were also analyzed for a variety of chemical constituents in surface water, groundwater, and ANL effluent water. Measurements of external penetrating radiation dose were also determined. ANL wastewater is discharged into Sawmill Creek, and this creek was sampled above and below the site to evaluate the effect of ANL operations on its radioactive content. The nuclides (for which analyses were made) added to the creek in the wastewater, and the ingestion doses from their net average creek concentrations, if the creek water had been used as a potable water supply, were: hydrogen-3, 0.006 millirem (mrem)/yr; strontium-90, 0.09 mrem/yr; cesium-137, 0.06 mrem/yr; neptunium-237, 0.0005 mrem/yr; plutonium-239, 240, 0.0025 mrem/yr; and americium-241, 0.021 mrem/yr. The concentrations and corresponding doses are all very low compared to the 100 mrem/yr dose limit. Sawmill Creek flows into the Des Plaines River, which in turn flows into the Illinois River. The radioactivity levels in the rivers were similar to those in other streams in the area, and the radionuclides added to the creek by ANL wastewater had no measurable effect on the radioactive content of either the Des Plaines or Illinois Rivers. (Lantz-PTT)
W89-12108

UNDERGROUND COAL GASIFICATION CONTAMINANT CONTROL PROGRAM: SIMULATION OF POSTBURN UCG CONTAMINANT PRODUCTION.
University of Wyoming Research Corp., Laramie. Western Research Inst.
J. E. Boysen, C. G. Mones, J. M. Covell, S. Sullivan, and R. R. Glaser.
Available from the National Technical Information Service, Springfield, VA 22161, as PB89-102834. Price codes: A06 in paper copy, A01 in microfiche. Final Report No. GRI-88/0170, March 1988. 116p, 24 fig, 13 tab, 30 ref, 3 append. Gas Research Institute Contract 5086-253-1380.

Descriptors: *Simulation analysis, *Water pollution sources, *Water pollution prevention, *Water pollution treatment, *Coal gasification, Model studies, Groundwater pollution, Water pollution control, Mathematical models, Cost analysis, Operating policies, Field tests.

Minimizing the adverse impact of underground coal gasification (UCG) on local groundwater quality, has been the subject of laboratory and modeling research. The Clean Cavern Concept, developed to minimize UCG's impact on groundwater quality, was investigated using laboratory reactor simulations. Operating recommendations for UCG field testing were made based upon the results of the laboratory and numerical analyses of the simulations. The results of physical and numerical simulations of postburn UCG coal pyrolysis indicate that the liquid and gaseous coal pyrolysis products are the source of most UCG contaminants. Further, elimination of gas losses during and after UCG operations and reduction of postburn coal pyrolysis can greatly reduce the adverse environmental impact and subsequent mitigation costs of the process. This can be accomplished through operational constraints and by incorporating low-cost procedures during and after UCG termination. (Lantz-PTT)
W89-12114

EVALUATION OF THE SOURCES OF NITRATE IN GROUNDWATER NEAR MOUNT GAMBIER, SOUTH AUSTRALIA,
Commonwealth Scientific and Industrial Research Organization, Canberra (Australia). Div. of Water and Land Resources.
P. J. Dillon.
Commonwealth Scientific and Industrial Research Organization Water Resources Series No 1, 62p, 30 fig, 22 tab, 66 ref, 5 append.

Descriptors: *Water pollution sources, *Nitrates, *Groundwater pollution, *Australia, Mount Gambier, Nonpoint pollution sources, Groundwater quality, Farm wastes, Aquifers.

Nitrate concentrations in groundwater exceeded 45 mg/L over 270 sq km in a 1000 sq km pastoral study area in the Lower South East of South Australia. Sources of nitrogen include dairies, cheese factories and abattoirs (point sources), and livestock urine leached from leguminous pasture (a diffuse source). Twenty-seven percent of the study area has a long term loss of potable supply due to nitrate concentrations exceeding 45 mg/L (the drinking water guideline). Nitrate concentrations exceed 10 mg/L over 80% of the study area. Most of this deterioration has occurred as a byproduct of primary industry over the last century. In spite of numerous data for evaluating the current state of the groundwater resource very few are useful for predicting future groundwater quality. Two viable scenarios are presented-one showing no increase in current concentrations the other a four fold increase. Steady state will not be reached for 500 yrs but 50% of the aquifer could exceed 45 mg/L within 100 yrs. Until a study of recharge nitrate concentration or aquifer stratification is performed the future water quality in the aquifer cannot be forecast. The dominant source of nitrate in the aquifer is atmospheric nitrogen fixed by clovers. Grazing stock accelerate the mineralization process and redistribute nitrogen unevenly over pastures thereby enhancing nitrate leaching. Soil above the water table contains 20 to 30 yrs worth of leached nitrate. Point sources contribute only a small fraction (around 11%) of the current total nitrogen load on the aquifer. Contaminant plumes from > 300 past and present point sources will

remain in the aquifer for centuries and disperse at an unknown rate. (Lantz-PTT)
W89-12132

SOIL SALINITY: IRRIGATION PRACTICES AND EFFECTS ON CROPS AND GROUND WATER, JANUARY 1977-MAY 1988: CITATIONS FROM THE SELECTED WATER RESOURCES ABSTRACTS DATABASE.
National Technical Information Service, Springfield, VA.
Available from National Technical Information Service, Springfield, VA 22161 as PB88-864509, Price codes: N01 in paper copy, N01 in microfiche. May 1988. 72p. Supersedes PB87-860292.

Descriptors: *Saline soils, *Irrigation effects, *Soil properties, *Groundwater pollution, *Water pollution sources, *Bibliographies, Saline water, Salt tolerance, Crop yield, Irrigation practices.

This bibliography contains citations concerning the effects on crops and groundwater from saline irrigation waters. The salt tolerance of crops, including beans, grains, and citrus fruits, are examined. Soil and groundwater salinity, and surface water salinity are discussed, and the sources of brackish waters are considered. This updated bibliography contains 188 citations of which 28 are new entries to the previous edition. (Author's abstract)
W89-12144

ACID MINE DRAINAGE, OCTOBER 1978-MAY 1988: CITATIONS FROM THE NTIS BIBLIOGRAPHIC DATABASE.
National Technical Information Service, Springfield, VA.
For primary bibliographic entry see Field 5A.
W89-12145

SANITARY LANDFALLS, JANUARY 1978-APRIL 1988: CITATIONS FROM THE NTIS BIBLIOGRAPHIC DATABASE.
National Technical Information Service, Springfield, VA.
Available from National Technical Information Service, Springfield, VA 22161 as PB88-863089, Price codes: N01 in paper copy, N01 in microfiche. April 1988. 130p. Supersedes PB87-859054.

Descriptors: *Water pollution sources, *Groundwater pollution, *Leachates, *Landfills, *Bibliographies, Sanitary landfills, Linings, Methane.

This bibliography contains citations concerning the design, operation, and management of sanitary landfills. Topics include liner materials evaluations, leachate analyses, site studies, environmental monitoring, and solid waste management strategies. Coal conversion and electric utility waste products, municipal refuse, and dredged materials disposal are considered. Considerable attention is given to methane recovery operations. Citations pertaining specifically to land disposal of hazardous materials are excluded. This updated bibliography contains 364 citations of which 31 are new entries to the previous edition. (Author's abstract)
W89-12150

HEAVY METALS IN DRINKING WATER: STANDARDS, SOURCES, AND EFFECTS, JANUARY 1977-DECEMBER 1987: CITATIONS FROM THE SELECTED WATER RESOURCES ABSTRACTS DATABASE.
National Technical Information Service, Springfield, VA.
For primary bibliographic entry see Field 5F.
W89-12161

POLYCHLORINATED BIPHENYLS: OCCURRENCE IN SEDIMENTS AND SOILS, JANUARY 1977-JANUARY 1988: CITATIONS FROM THE SELECTED WATER RESOURCES ABSTRACTS DATABASE.
National Technical Information Service, Springfield, VA.
Available from National Technical Information Service, Springfield, VA 22161 as PB88-857123, Price codes: N01 in paper copy, N01 in microfiche. January 1988. 82p. Supersedes PB87-855102.

Descriptors: *Water pollution sources, *Polychlorinated biphenyls, *Bibliographies, *Pollutant identification, Dredging, Sediments, Soil contamination, Chemical analysis, Biodegradation, Bioaccumulation, Chlorinated hydrocarbons.

This bibliography contains citations concerning field and laboratory analyses of polychlorinated biphenyls in sediments and soils. Topics include site studies, chemical analyses of adsorption-desorption processes, decomposition in soils, including biodegradation, and bioaccumulation. Detection methods and equipment, and the impact of dredging in contaminated areas are also discussed. This updated bibliography contains 207 citations of which 28 are new entries to the previous edition. (Author's abstract)
W89-12169

POLYCHLORINATED BIPHENYLS IN THE FRESHWATER ENVIRONMENT, JANUARY 1977-JANUARY 1988: CITATIONS FROM THE SELECTED WATER RESOURCES ABSTRACTS DATABASE.
National Technical Information Service, Springfield, VA.
For primary bibliographic entry see Field 5C.
W89-12170

BIODETERIORATION OF OIL SPILLS, JANUARY 1970-JANUARY 1988: CITATIONS FROM THE NTIS BIBLIOGRAPHIC DATABASE.
National Technical Information Service, Springfield, VA.
For primary bibliographic entry see Field 5G.
W89-12171

GROUND WATER POLLUTION: GENERAL STUDIES, DECEMBER 1984-JANUARY 1988: CITATIONS FROM THE NTIS BIBLIOGRAPHIC DATABASE.
National Technical Information Service, Springfield, VA.
Available from National Technical Information Service, Springfield, VA 22161 as PB88-857016, Price codes: N01 in paper copy, N01 in microfiche. January 1988. 107p. Supersedes PB87-851655.

Descriptors: *Groundwater pollution, *Bibliographies, *Water pollution sources, *Pollutant identification, *Path of pollutants, Monitoring, Landfills, Mine drainage, Superfund, Leachates, Mathematical models, Model studies, Aquifers.

This bibliography contains citations concerning sources, contaminant transport, and monitoring of pollutants in aquifers. Topics include pollution characterization from landfills and mine drainage, descriptions of study programs undertaken by specific states, and superfund site studies of contaminated areas. The utilization of mathematical models is also discussed. Studies pertaining specifically to irrigation, and pollution from fertilizers are excluded. This updated bibliography contains 319 citations of which 94 are new entries to the previous edition. (Author's abstract)
W89-12172

5C. Effects Of Pollution

ENTERIC VIRUS: RISK ASSESSMENT OF OCEAN DISPOSAL OF SEWAGE SLUDGE.
Arizona Univ., Tucson. Dept. of Nutrition and Food Science.
C. P. Gerba, and S. M. Goyal.
Water Science and Technology WSTED4, Vol. 20, No. 11/12, p 25-31, 1988. 1 tab, 34 ref.

Descriptors: *Risk assessment, *Sludge disposal, *Ocean dumping, *Water pollution effects, *Enteroviruses, *Public health, Coastal waters, Human diseases, Population exposure, Waste disposal, Marine environment, Human pathogens.

Densely populated coastal regions of the world generate large quantities of domestic sewage sludge, which is often disposed into the marine environment. Present in these wastes are human pathogenic viruses that are capable of surviving for prolonged periods of time in the marine environment and transmitting disease to humans by a number of potential routes of which swimming and marine foods consumption are the most significant. Hepatitis A virus and Norwalk virus outbreaks associated with shellfish consumption continue to occur in the United States. Three separate epidemiological studies have also shown an association between shellfish consumption and increased risk of hepatitis A infection in consumers. An epidemiological association between non-A and non-B hepatitis has also been demonstrated. The risks of infection, clinical illness and mortality associated with enteroviruses are reviewed. The presence of these viruses in shellfish and bathing waters present a significant risk to the consumer. (Author's abstract)
W89-11073

HEPATITIS A VIRUS LEVELS IN SHELLFISH EXPOSED IN A NATURAL MARINE ENVIRONMENT TO THE EFFLUENT FROM A TREATED SEWAGE OUTFALL.
Centre d'Etudes et de Recherches de Biologie et d'Oceanographie Medicale, Nice (France).
For primary bibliographic entry see Field 5A.
W89-11101

EFFECTS OF SEAWATER CONTAMINATION LEVEL AND EXPOSURE PERIOD ON THE BACTERIAL AND VIRAL ACCUMULATION AND ELIMINATION PROCESSES BY MYTILUS EDULIS.
Newcastle upon Tyne Univ. (England). Dept. of Civil Engineering.
M. M. F. Mesquita.
Water Science and Technology WSTED4, Vol. 20, No. 11/12, p 265-270, 1988. 2 fig, 1 tab, 10 ref.

Descriptors: *Mytilus, *Bioaccumulation, *Water pollution effects, *Shellfish, *Mussels, *Coliforms, *Viruses, Bacteria, Seawater, Growth media, Escherichia coli, Culturing techniques, Population exposure.

A study was undertaken to explain the effects of seawater contamination level and shellfish exposure period on depuration efficiency of the common mussel (Mytilus edulis). Bacterial indicators (E. coli, group D fecal streptococci) and coliphage, cultured in vitro and present in settled sewage, were used as contaminants. Mussels were exposed to low levels (100-1,000 CFU and PFU/100 ml) of seawater contamination for 24 h and to high levels (10,000-1,000,000 CFU and PFU/100 ml) for 30 m. Both types of contaminants, under the same conditions, gave rise to similar depuration patterns. Low titers accumulated over an extended period appear to cause prolonged retention of a portion of the phage, independently of mussel activity as measured by bacterial elimination. Exposure to high titers for a short period, on the other hand, determines more rapid phage elimination but only down to a certain level. A percentage of bacteriophages is always retained in shellfish tissues after 48 h depuration. These findings indicate that procedures currently in use for depuration of commercial bivalve shellfish, based on E. coli removal within 48 h, are ineffective in completely removing bacterial viruses and probably also viruses of public health importance from such shellfish. (Author's abstract)
W89-11106

GROWTH OF FILAMENTOUS BACTERIA IN THE PRESENCE OF HEAVY METALS.
Pennsylvania State Univ., University Park. Program in Ecology.
For primary bibliographic entry see Field 5D.
W89-11143

SEASONAL CHANGES IN SIZE-FRACTIONATED PRIMARY PRODUCTION AND NUTRIENT CONCENTRATIONS IN THE TEMPER-

ATE NERITIC WATER OF FUNKA BAY, JAPAN.
Hokkaido Univ., Hakodate (Japan). Faculty of Fisheries.
Y. Maita, and T. Odate.
Journal of the Oceanographical Society of Japan NKGKB4, Vol. 44, No. 6, p 268-279, December 1988. 8 fig, 2 tab, 34 ref.

Descriptors: *Water pollution effects, *Eutrophication, *Neritic environment, *Phytoplankton, *Diatoms, *Primary productivity, *Nutrients, Chlorophyll a, Carbon radioisotopes, Seasonal variation, Funka Bay, Japan.

Size-fractionated primary productivity and chlorophyll a concentration were studied at two stations in the temperate neritic water of Funka Bay, Japan, from April 1984 to May 1985. Size distributions of phytoplankton were discussed in relation to nutrient availability. In the central part of the bay, 66% of the annual primary production occurred during the spring phytoplankton bloom with 95% of the spring production being accounted for by the greater than 10 micron size fraction, which was dominated by diatoms. The increase in this large fraction was enhanced at both stations when nutrient concentrations increased in the bay's upper layer. Under low nutrient concentrations during summer, small phytoplankters (<2 microns) accounted for 40-75% of the total C14 uptake at the central station, and from 25-59% at the coastal station. However, a sudden nutrient enrichment at the coastal station during the summer triggered the growth of the larger size fraction. These seasonal and regional changes in total C14 uptake were attributed to the large size fraction, composed mainly of diatoms. From the decreases in various nutrients during diatom blooms, it was suggested that the predominance of diatoms were determined not only by nutrient concentrations but also by their relative availability. (Author's abstract)
W89-11180

USE OF THE STRUCTURAL MODEL FOR THE ASSESSMENT OF ENVIRONMENTAL IMPACT ON COASTAL FISHERIES: PRINCIPLES AND PROCEDURES,
Tokyo Univ. (Japan). Ocean Research Inst.
H. Nakata, and T. Hirano.
Nippon Suisan Gakkaishi (Bulletin of the Japanese Society of Scientific Fisheries) NSUGAF, Vol. 55, No. 2, p 273-278, February 1989. 4 fig, 1 tab, 13 ref.

Descriptors: *Environmental effects, *Coastal zone management, *Marine fisheries, *Model studies, Ecology, Environmental protection, Fisheries, Coastal waters.

The utility of the structural model as a tool for the assessment of environmental impact on coastal fisheries, along with its principles and procedures, is presented. Existing information is used for structuring comprehensive ecological systems of fishing grounds and evaluating their functional change both directly and indirectly due to various impacts. A simple empirical formulation scheme is proposed as a means of quantifying the environmental impact. A set of variables, each of which indicates the rate deviation from the present state of each environmental factor, is used for the formulation. Interaction matrices are used to systematically identify the structure of the system to be assessed. Such matrices enable easy visualization of the path of the disturbance caused by proposed actions. Each variable is normalized over the range (0-1) where the upper boundary is defined for the present state and the lower boundary for the largest impacted state. Thus, it also becomes possible to use simple multiplication to calculate the effects of multiple factors on a single factor. By inputting an initial value to the formulated structural model, a possible impact on fisheries can be estimated, e.g., in terms of relative catch loss. Although this method has several limitations when handling feedback processes, etc., it appears to make conventional methods more accurate and quantitative. (Friedmann-PTT)
W89-11289

USE OF THE STRUCTURAL MODEL FOR THE ASSESSMENT OF ENVIRONMENTAL IMPACT ON COASTAL FISHERIES: AN APPLICATION,
Tokyo Univ. (Japan). Ocean Research Inst.
For primary bibliographic entry see Field 4C.
W89-11290

EFFECTS OF WATER HARDNESS ON THE TOXICITY AND ACCUMULATION OF CADMIUM IN EGGS AND LARVAE OF MEDAKA, ORYZIAS LATIPES, (JAPANESE).
Kyushu Univ., Fukuoka (Japan). Faculty of Agriculture.
H. Nakagawa, and S. Ishio.
Nippon Suisan Gakkaishi (Bulletin of the Japanese Society of Scientific Fisheries) NSUGAF, Vol. 55, No. 2, p 321-326, February 1989. 2 fig, 5 tab, 21 ref. English summary.

Descriptors: *Toxicity, *Bioaccumulation, *Water pollution effects, *Cadmium, *Heavy metals, *Larvae, Chemical properties, Eggs, Trace elements.

Effects of water hardness on the toxicity and accumulation of Cd(2+) in the eggs and the larvae of Oryzias latipes were studied. With increasing water hardness, the toxicity of Cd(2+) on the eggs and the larvae decreased, also the amounts of Cd(2+) accumulated by the eggs, the chorions, and the larvae declined. On the other hand, the contents of Ca and Mg in the eggs and the chorions increased. It is hypothesized that the toxicity of Cd(2+) on the eggs and the larvae were ameliorated with increasing water hardness because hard water caused suppression of accumulation of Cd(2+) by the eggs and the larvae since Cd(2+) has to compete with Ca(2+) and Mg(2+) for active sites in the uptake channel. (Author's abstract)
W89-11291

EFFECTS OF WATER PH ON THE TOXICITY AND ACCUMULATION OF CADMIUM IN EGGS AND LARVAE OF MEDAKA, ORYZIAS LATIPES, (JAPANESE).
Kyushu Univ., Fukuoka (Japan). Faculty of Agriculture.
H. Nakagawa, and S. Ishio.
Nippon Suisan Gakkaishi (Bulletin of the Japanese Society of Scientific Fisheries) NSUGAF, Vol. 55, No. 2, p 327-331, February 1989. 6 fig, 1 tab, 11 ref. English summary.

Descriptors: *Hydrogen ion concentration, *Toxicity, *Bioaccumulation, *Cadmium, *Water pollution effects, *Larvae, *Heavy metals, Chemical properties, Trace elements, Eggs.

Effects of water pH on the toxicity and accumulation of cadmium in the eggs and the larvae of Oryzias latipes were studied. Within the range of pH 4.5-7.0, the toxic effects of Cd(2+) on the eggs increased in groups with a lower pH. In groups with a higher pH, those effects were ameliorated. However, at pH 4.0, the eggs hatched minimally and abnormalities were observed in all larvae of all test groups, including controls. In the same pH ranges, the amounts of Cd(2+) accumulated by the eggs and the larvae were depressed with lowered pH. Thus, the toxic effects of Cd(2+) on the larvae were ameliorated because the amounts of Cd(2+) accumulated by the larvae were depressed with decreasing water pH. Nevertheless, the reason that the toxic effects of Cd(2+) on the eggs increased with lowering water pH could not be explained from the result of a Cd(2+) accumulation test. (Author's abstract)
W89-11292

GROWTH RESPONSE OF BACTERIA TO EXTRACELLULAR PRODUCTS OF BLOOM ALGAE.
Kyoto Univ. (Japan). Dept. of Fisheries.
C. E. Riquelme, K. Fukami, and Y. Ishida.
Nippon Suisan Gakkaishi (Bulletin of the Japanese Society of Scientific Fisheries) NSUGAF, Vol. 55, No. 2, p 349-355, February 1989. 9 fig, 1 tab, 24 ref. Ministry of Education and Culture of Japan Grant 58560189.

Descriptors: *Growth rates, *Growth kinetics, *Bacteria, *Algal blooms, *Biochemistry, *Water pollution effects, Microbes, Eutrophication, Pseudomonas, Organic compounds, Carbon, Amino acids, Diatoms.

The growth response of native bacteria isolated from Maizuru Bay (Japan) to extracellular organic carbon (EOC) of Asterionella glacialis (Bacillariophyceae) and Chattonella marina (Rhaphidophyceae) was examined. A. glacialis EOC selectively stimulated and inhibited the bacterial growth. Growth of a dominant strain Pseudomonas 022 during the bloom of A. glacialis was strongly stimulated by A. glacialis EOC, but the growth of Vibrios strains were not stimulated. Pseudomonas 022 utilized selectively not only dissolved free amino acid (DFAA) but also dissolved combined amino acid (DCAA) in the algal EOC. It is suggested that bacteria change the concentration and composition of dissolved amino acids released by microalgae. (Author's abstract)
W89-11293

CONGENITAL CARDIAC ANOMALIES IN RELATION TO WATER CONTAMINATION, SANTA CLARA COUNTY, CALIFORNIA, 1981-1983.
California Dept. of Health Services, Berkeley. Epidemiological Studies Section.
S. H. Swan, G. Shaw, J. A. Harris, and R. R. Neutra.
American Journal of Epidemiology AJEPAS, Vol. 129, No. 5, p 885-893, May 1989. 2 fig, 3 tab, 13 ref.

Descriptors: *Water pollution effects, *California, *Underground storage, *Leakage, *Cardiac anomalies, Trichloroethane, Chloroform, Epidemiology.

A county-wide epidemiological study of cardiac anomalies was conducted by the California Department of Health Services in the Santa Clara County in 1981-1983. In November 1981, a leak of solvents from an underground storage tank was detected at an electronics manufacturing plant in the county. Solvents (predominantly 1,1,1-trichloroethane, or methyl chloroform) were found in a nearby well which supplied drinking water to the surrounding community. Residents were concerned about a possible relation between adverse reproductive outcomes and consumption of contaminated water. The study looked at major cardiac anomalies among births throughout the county and found an increased prevalence in the service area of the water company which operated the contaminated well. During the potentially exposed time period (January 1981 through August 1982), 12 babies with major cardiac anomalies were born to residents of this area. This represents an excess of six cases over the number expected based on the prevalence in the remainder of the county (relative risk = 2.2, 95 confidence interval 1.2-4.0). No excess was observed in the unexposed time period (September 1982 through December 1983). However, the temporal distribution of major cardiac cases born during the exposed time period suggests that the solvent leak is an unlikely explanation for this excess. (Author's abstract)
W89-11298

ADVERSE PREGNANCY OUTCOMES IN RELATION TO WATER CONTAMINATION, SANTA CLARA COUNTY, CALIFORNIA, 1980-1981.
California Dept. of Health Services, Berkeley. Epidemiological Studies Section.
M. E. Deane, S. H. Swan, J. A. Harris, D. M. Epstien, and R. R. Neutra.
American Journal of Epidemiology AJEPAS, Vol. 129, No. 5, p 894-904, May 1989. 6 tab, 12 ref.

Descriptors: *Water pollution effects, *Teratogenic effects, *Organic compounds, *California, *Well water, Trichloroethane, Epidemiology.

An epidemiological study was conducted to investigate a suspected cluster of adverse outcomes of pregnancies conceived in 1980-1981 among women

who resided in a census tract in Santa Clara County, California that was thought to be exposed to drinking water from a well contaminated by an organic solvent, trichloroethane. A comparison census tract that received water from a different source was selected on the basis of demographic comparability. The cluster was confirmed; the odds ratio for spontaneous abortion was 2.3 (95% confidence interval (CI) 1.3-4.2) after adjustment by multiple logistic regression for maternal risk factors, including maternal age, alcohol consumption, smoking, and prior fetal loss. The relative risk for congenital malformations was 3.1 (95% CI 1.1-10.4). Because of the lack of precise information on the timing and extent of contamination, the pattern of spontaneous abortion rates through out the study period cannot be used to either support of refute a causal inference. (Author's abstract)
W89-11299

CONTINUITY OF MAIN STREAM RIVER BACTERIA DEMONSTRATED BY FACTOR ANALYSIS.
Windsor Univ. (Ontario). Dept. of Biology.
M. A. Holder-Franklin, M. Franklin, and T. Kaneko.
Internationale Vereinigung fur Theoretische und Angewandte Limnologie, Verhandlungen IVTLAP, Vol. 23, No. 4, p 1846-1854, December 1988. 8 fig, 2 tab, 4 ref.

Descriptors: *Water pollution effects, *Bacteria, *Food-processing wastes, Mathematical analysis, Canada, Factor analysis, Maine.

The impact of a food processing plant's effluent population on bacteria in the Saint John River (Maine) was determined. At the sampling point, the river was 250 miles from the sea and was 20 feet at its deepest and 1/4 mile wide. The banks are often flooded in the spring and there is considerable spring run-off. The samples were obtained one mile above, one mile below, and at the entry of the effluent of a food processing plant, the products being frozen vegetables and the effluent having a heavy starch content from potatoes. The effluent was highly alkaline and had not been treated but was held in a settling tank for 10-12 hours before discharge. The effluent strains were distinctly different from the river strains for all seasons. Although they may have been identified as being in the same genus, they did not cluster with the river strains. When representatives of each cluster for September and February data sets were numerically analyzed, the Aeromonas strains in the effluent samples clustered together. The strains from samples above and below the effluent frequently clustered and indeed most of the clusters were mixed. The numerical taxonomy gives an indication of the continuity of the main stream bacteria. The factor analysis substantiated the conclusion that the river strains were similar above and below the effluent. The factors are interpreted as physiological groupings and the strains can be, but need not be identified as in numerical taxonomy. The database of test response provide a physiological profile of the bacterial isolates, however, a multivariate analysis is required to extract the information necessary to reveal a possible ecological significance. (Miller-PTT)
W89-11307

LIGHT UTILIZATION EFFICIENCY AS A FUNCTION OF STORED CO2 IN LEAVES OF SOME ACIDTOLERANT AQUATIC MACROPHYTES.
Uppsala Univ. (Sweden). Limnologiska Institutionen.
For primary bibliographic entry see Field 2H.
W89-11321

STUDIES ON PERIPHYTON ALGAE IN THE PETROLEUM OIL SPILLAGES AREA OF THE NIGER DELTA AQUATIC SYSTEM.
Rivers State Univ. of Science and Technology, Port Harcourt (Nigeria).
J. K. Pudo, and D. M. Fubara.
Internationale Vereinigung fur Theoretische und Angewandte Limnologie, Verhandlungen IVTLAP, Vol. 23, No. 4, p 2259-2261, December 1988. 1 tab, 8 ref.

Descriptors: *Bioindicators, *Water pollution effects, *Deltas, *Niger Delta, *Oil spills, *Algae, Periphyton, Cyanophyta, Diatoms, Coastal areas, Tropical regions.

Investigations of the effects of oil spills in the Niger delta were carried out in one hydrological cycle, including rainy and dry seasons tidal water where the effluent from the Petroleum Refinery was discharged. This is a tropical, coastal ecosystem where oil products create an oily coating on water surface. Samples of periphyton were collected from the piles of a jetty during low water at a time the periphyton was covered with a film of oil. The most abundant algae were Cyanophyta and Bacillariophyta. Some of them were found well developed in the region of oil pollution and some had decreased in population. The physico-chemical characteristics of water were also studied. The periphyton samples contained numerous plant organisms but some representatives of bacteria were present in addition to algae. Diatoms were found in large numbers during the research year, but species differences were observed between stations. The results confirmed the statement that the periphyton community is a good indicator of water quality. When comparing the qualitative and quantitative composition of organisms of the first and second sampling stations, differences were found within the community. The species composition was almost the same, but there were some quantitative differences. Diatoms, in particular, have been found to be very sensitive to environmental changes. Some of them (such as Melosira undulata, Cyclotella striata, Nitzschia obtusa var. scalpelliformis) decreased very greatly in number at station 1, which was oil polluted. They are very sensitive to oil pollution. Other diatoms as Coscinodiscus rothii var. subsalsa, Caloneis formosa and Pleurosigma elongatum, developed well at station 1 and even increased in population. They are, therefore, resistant to oil pollution. (Miller-PTT)
W89-11340

RELATIONSHIPS BETWEEN SEEPAGE CHEMISTRY AND FLOW PATH THROUGH THE NEAR-SHORE SEDIMENTS OF AN ACIDIC LAKE.
Old Dominion Univ., Norfolk, VA. Dept. of Civil Engineering.
G. C. Schafran, and C. T. Driscoll.
Internationale Vereinigung fur Theoretische und Angewandte Limnologie, Verhandlungen IVTLAP, Vol. 23, No. 4, p 2262-2266, December 1988. 4 fig, 12 ref.

Descriptors: *Acid rain effects, *Groundwater movement, *Seepage, *Geochemistry, *Water chemistry, *Lakes, *Acidic water, Sediments, Hydrogen ion concentration, Flow pattern.

The variation of groundwater inputs in the near-shore region of an acidic lake was investigated, and the biogeochemical processes occurring within the near-shore sediments that influence seepage chemistry were assessed. Seepage flow rate for the transect indicated that the highest rate of flow occurred near the shore and decreased exponentially with the distance from the shore. Seepage was observed to be the most acidic at the nearest-to-shore site and decreased with the distance from shore. Temporal variations of H(+) concentrations were not substantial throughout the study. However, temporal variations of the acid anions SO4(--) and NO3(-) were significant. Although seepage chemistry and velocity were monitored, the actual inputs of solutes to the lake are difficult to assess. The transformations that may occur over the 0-10 cm depth in the sediments may significantly alter seepage chemistry. Nonetheless, these results indicate that seepage chemistry is highly dependent on the flow path and is consistent with earlier studies that reported the importance of the hydrologic pathway in controlling groundwater chemistry. (Miller-PTT)
W89-11341

EFFECTS OF ACIDIFICATION ON THE INVERTEBRATE PORTION OF THE AUFWUCHS IN A MESOCOSM EXPERIMENT,
Wisconsin Dept. of Natural Resources, Madison.
P. J. Garrison, and K. E. Webster.
Internationale Vereinigung fur Theoretische und Angewandte Limnologie, Verhandlungen IVTLAP, Vol. 23, No. 4, p 2273-2278, December 1988. 2 fig, 1 tab, 12 ref.

Descriptors: *Acid rain effects, *Water pollution effects, *Aquatic insects, *Lakes, *Acidic water, *Macroinvertebrates, Midges, Caddisflies, Oligochaetes, Waterfleas, Aufwuchs.

As part of a multidisciplinary study investigating whole-lake responses to acidification, one basin of Little Rock, a small (18 ha) seepage lake in northern Wisconsin (initial pH 6.1), is being acidified with electrolytic-grade sulfuric acid in half pH unit steps. Companion studies using mesocosms were conducted to predict lake responses and examine interactions as the lake acidification progresses, and the responses of the invertebrate community associated with aufwuchs to three levels of acidity in mesocosms reported. The dominant macroinvertebrates of the aufwuchs at all levels were Chironomidae and Ceratopogonidae. The chironomids were dominated by Orthocladiinae with Chironomini also abundant at times. Trichopterans (largely Oxyethira), the only other insect order represented, were restricted to the acidified mesocosms. Oligochaetes were present in the control and pH 5.0 mesocosms but not at pH 4.5. The most common crustaceans collected were Sida crystallina, Acroperus harpae, Chydorus sphaericus, and Ophyryoxus harpae. Significant but opposite effects of the acid treatment were observed for two cladocerans at pH 4.5: (1) densities of Sida declined to a small proportion of that observed in the other treatments, and (2) densities of Ophryoxus showed the opposite trend. Densities of other cladocerans were not significantly different between the acidity levels. The effect of acidity upon the macroinvertebrate community was in agreement with acid sensitivities reported in the literature. Results suggest that the zooplankter Acropperus may increase with acidity. Results also showed significantly lower densities of Sida in both pH 4.5 mesocosms compared to other non-fish mesocosms at pH 6.0 and 5.0. In contrast, Ophryoxus displayed the opposite trend towards highest densities at the lowest pH. The increase in Ophryoxus may not be due to acidity, but instead to competition by Sida. (Miller-PTT)
W89-11343

EARLY ZOOPLANKTON RESPONSE TO EXPERIMENTAL ACIDIFICATION IN LITTLE ROCK LAKE, WISCONSIN, USA.
Wisconsin Univ.-Madison. Center for Limnology.
T. M. Frost, and P. K. Montz.
Internationale Vereinigung fur Theoretische und Angewandte Limnologie, Verhandlungen IVTLAP, Vol. 23, No. 4, p 2279-2285, December 1988. 8 fig, 1 tab, 19 ref.

Descriptors: *Lakes, *Acidic water, *Little Rock Lake, *Zooplankton, *Acid rain effects, *Water pollution effects, *Comparison studies, *Experimental basins, Hydrogen ion concentration, Food chains.

Early results from the Little Rock Lake Experimental Acidification Project characteristics of the zooplankton community are reported. While focusing on the abundance patterns of the four dominant zooplankton taxonomic groups, a preliminary comparison between the lake's two basins during a one-year baseline period, and two years in which the North basin was acidified, is described. Data suggest that zooplankton responses to acidification, particularly in its early stages, are likely to involve indirect and complex food web interactions rather than direct responses to acid conditions. Two lines of evidence suggest the importance of complex interactions in the response of zooplankton to acidification in Little Rock Lake. The first is simply the observation that some taxa appear to increase with decreasing pH. Such a response could also result, however, when certain species are more efficient energetically under more acid conditions. Complex interactions are also suggested by a second feature of the results. If zooplank-

ton species were directly affected by pH conditions, they would be expected to respond to acidification within a few generations. Consequently, zooplankton responses would have occurred in the first year of Little Rock's acidification in 1985 and would have been parallel in 1985 and 1986. The patterns observed show little consistency between 1985 and 1986. They suggest, instead that zooplankton respond to subsequent food chain shifts. (Miller-PTT)
W89-11344

MONITORING OF ACIDIFICATION BY THE USE OF AQUATIC ORGANISMS.
Bergen Univ. (Norway). Zoological Museum.
For primary bibliographic entry see Field 7B.
W89-11346

IMPACT OF WASTE DISCHARGES ON CORAL REEF REGIONS,
Queensland Univ., Brisbane (Australia). Dept. of Chemical Engineering.
P. R. F. Bell, P. F. Greenfield, D. Hawker, and D. Connell.
Water Science and Technology WSTED4, Vol. 21, No. 1, p 121-130, 1989. 5 tab, 18 ref.

Descriptors: *Water pollution effects, *Wastewater disposal, *Reefs, *Corals, Tourism, Tolerance, Runoff, Nutrients, Phosphorus, Nitrogen.

Tolerance level data as derived from the Great Barrier Reef (Australia) are summarized. Tolerance levels of the various contaminants in the runoff, groundwater and sewage discharges from tourist developments can be used to evaluate various waste-management options. Runoff and sewage discharges from tourist resorts have the potential to cause serious adverse impacts in coral-reef communities. The components of most concern are the nutrients nitrogen and phosphorous. The available evidence implies that coral reef environments are particularly sensitive to small increases in the background phosphorous levels. This means that reefs in the vicinity of small discharges can be seriously affected. The available evidence also implies that denitrification and phosphorous removal are necessary treatment requirements if acceptable levels (after dilution) of these components are to be achieved. In regions with significant rainfall, efforts need to be made to ensure that run-off is not discharged in the vicinity of fringing reefs. Run-off should preferably be stored and reused, or discharged through a submarine diffuser. Treatment prior to discharge for the removal of nutrients may be necessary. (Miller-PTT)
W89-11359

DETERGENTS AS A CONDITION OF POLLUTION FROM COASTAL MARINE AEROSOL.
Florence Univ. (Italy). Lab. of Technical Physical Chemistry.
G. Loglio, N. D. Innocenti, R. Gellini, F. Pantani, and R. Cini.
Marine Pollution Bulletin MPNBAZ, Vol. 20, No. 3, p 115-119, March 1989. 3 fig, 14 ref.

Descriptors: *Bioindicators, *Water pollution effects, *Path of pollutants, *Detergents, *Coastal waters, *Aerosols, Marine environment, Surfactants, Vegetation effects, Synergistic effects.

Experimental evidence of damage of a Pinus pinea foliage by detergent surfactants in aerosol from marine water solutions is shown. Typical natural non-detergent surfactants from the coastal marine environment, such as humic acids, do not cause per se damage although they could become a vehicle of polluting agents in marine aerosols. Taking into account that the damage mechanism due to the detergent can be generalized to all types of coastal vegetation, this damage is suggested as in a first indication of marine pollution due to human discharge essentially of urban origin. It is shown that the damage process previously ascribed to the synergic effect of surfactants and marine salts is certainly due to the detergent properties of those synthetic surfactants normally used as commercial detergents. (Miller-PTT)
W89-11383

HISTORIC TRENDS IN LAKE MICHIGAN SILICA CONCENTRATIONS.
Michigan Univ., Ann Arbor. Great Lakes Research Div.
C. L. Schelske.
Internationale Revue der Gesamten Hydrobiologie IGHYAZ, Vol. 73, No. 4, p 559-591, 1988. 17 fig, 5 tab, 62 ref.

Descriptors: *Limnology, *Eutrophication, *Water pollution effects, *Lake Michigan, *Silica, *Sedimentation, Diatoms, Phosphorus, Enrichment.

Historic data on soluble silica in the offshore waters of Lake Michigan were compiled and analyzed to determine whether the data supported a decrease in silica concentration which had been hypothesized previously on the basis of other studies. Although the data base was limited and no data were obtained for offshore waters (depths > 40 m) prior to 1954, the available data support the conclusion that the silica concentration decreased rapidly after 1954. The thesis is developed that rapid silica depletion occurred in the 15-year period from 1954 to 1969 when the winter maximum concentration decreased from approximately 4.4 to 1.4 mg SiO2/l and the summer minimum decreased from approximately 2.2 to $<$ 0.2 mg SiO2/l. The decrease in silica concentration is attributed to increased production and sedimentation of diatoms that resulted from increased anthropogenic phosphorous loading. Total phosphorous in offshore waters was probably $<$10 microg P/l during the period of rapid silica depletion. The rapid decrease in silica concentration with relatively small phosphorous enrichment demonstrates that the tight coupling of biological and geochemical processes drastically affected the biogeochemistry of silica in a large, aquatic system within a relatively short period of time. (Author's abstract)
W89-11393

TOXICITY OF WATER FROM THREE SOUTH CAROLINA RIVERS TO LARVAL STRIPED BASS.
National Fisheries Contaminant Research Center, Columbia, MO.
S. E. Finger, and J. S. Bulak.
Transactions of the American Fisheries Society TAFSAI, Vol. 117, No. 6, p 521-528, November 1988. 1 fig, 5 tab, 18 ref.

Descriptors: *Heavy metals, *Toxicity, *Water pollution effects, *Rivers, *Fish, *South Carolina, Fishkill, Bass, Larval growth stage, Phenols.

The toxicity of water from three rivers in the Santee-Cooper drainage of South Carolina was evaluated in a series of on-site studies with larval striped bass, Morone Saxatilis. Mortality and swimming behavior were assessed daily for larvae exposed to serial dilutions of water collected from the Santee, Congaree, and Wateree rivers. After 96 h, cumulative mortality was 90% in the Wateree River, and a dose-response pattern was evident in serial dilutions of the water. Larvae exposed to water from the Santee and Congaree rivers swam lethargically, but no appreciable mortality was observed. Acutely toxic concentrations of inorganic contaminants were not detected in the rivers; however, pentachloroanisole, a methylated by-product of pentachlorophenol, was twice as high in the Wateree River as it was in the other two rivers. Phenolic compounds may have contributed to larval mortality in the Wateree River and to lethargic activity of larvae in the Santee and Congaree rivers. (Author's abstract)
W89-11395

TAINTING AND DEPURATION OF TAINT BY LOBSTERS (HOMARUS AMERICANUS) EXPOSED TO WATER CONTAMINATED WITH A NO. 2 FUEL OIL: RELATIONSHIP WITH AROMATIC HYDROCARBON CONTENT IN TISSUE.
Department of Fisheries and Oceans, St. Andrews (New Brunswick).
U. P. Williams, J. W. Kiceniuk, L. L. Fancey, and J. R. Botta.
Journal of Food Science JFDSAZ, Vol. 54, No. 2, p 240-243, March-April 1989. 10 tab, 19 ref.

Descriptors: *Lobsters, *Oil pollution, *Fuel, *Odors, *Taste, Water pollution effects, Hydrocarbons, Bioaccumulation.

Lobsters (Homarus americanus) held in 2700 liter tanks were exposed to a pulse (surface slick of 25 ml) of diesel oil and held for 21 days to depurate. Taste panels revealed a highly significant difference between samples, as well as a preference for the untreated samples at days 10 and 11. The odor of the raw treated samples differed significantly from that of the control at each of the sampling times. Cooking appeared to remove the oily odor from the raw lobster. Significantly elevated concentrations of total aromatics were found in the hepatopancreas of both sexes at days 3-4 and 10-11 and in the tail muscle of male and female lobsters 10-11 days after initial exposure and decreased thereafter. Tainting of lobsters can occur within 10 days of exposure to diesel, and this effect can be reversed within 20 days after initial exposure. (Author's abstract)
W89-11400

INFLUENCE OF AQUEOUS ALUMINIUM AND ORGANIC ACIDS ON MEASUREMENT OF ACID NEUTRALIZING CAPACITY IN SURFACE WATERS.
Corvallis Environmental Research Lab., OR.
For primary bibliographic entry see Field 5B.
W89-11401

EFFECT OF COPPER AND ZINC ON THE GROWTH AND EMERGENCE OF EPEORUS LATIFOLIUM (EPHEMEROPTERA) IN AN INDOOR MODEL STREAM.
National Inst. for Environmental Studies, Ibaraki (Japan). Environmental Biology Div.
S. Hatakeyama.
Hydrobiologia HYDRB8, Vol. 174, No. 1, p 17-27, April 1989. 6 fig, 2 tab, 15 ref.

Descriptors: *Copper, *Zinc, *Model studies, *Mayflies, *Growth, *Water pollution effects, Aquatic insects, Heavy metals, Streams, Food chains, Diatoms, Algae.

Effects of Cu and Zn through food as well as through the water on the growth and emergence of the young larvae of Epeorus latifolium (Ephemeroptera), were investigated using an indoor model stream. The critical lowest concentrations of Cu which have significant effects on the growth of the larvae were between 10 and 15 micrograms/liter Cu. Growth and emergence of the larvae fed on the algae (diatoms) which accumulated more than 1000 micrograms Cu/g (dry wt.) were significantly impaired. Growth of the mayfly larvae exposed to 100 or 300 micrograms/liter Zn ceased after the second week, and all died before emergence. At 30 micrograms/liter Zn, the growth rate decreased gradually and many larvae died before emergence. The molt interval also nearly doubled that of the control at these concentrations. Growth and emergence of the mayfly fed the algae which accumulated more than 2000 micrograms/g of Zn were significantly affected. (Author's abstract)
W89-11412

EUTROPHICATION OF LAKE NEUCHATEL INDICATED BY THE OLIGOCHAETE COMMUNITIES.
Conservation de la Faune, Saint-Sulpice (Switzerland).
C. Lang.
Hydrobiologia HYDRB8, Vol. 174, No. 1, p 57-65, April 1989. 3 fig, 2 tab, 15 ref.

Descriptors: *Eutrophic lakes, *Oligotrophic lakes, *Mesotrophic lakes, *Water pollution effects, *Oligochaetes, *Eutrophication, Population dynamics, Dissolved oxygen, Trophic level, Switzerland.

Lake Neuchatel (Switzerland), oligotrophic until 1950, was meso-eutrophic in 1980. The relative abundance in worm communities of Peloscolex velutinus and Stylodrilus heringianus was used to monitor the trophic state of the lake. In 1980, the median relative abundance of these oligotrophic species was 9% in the whole of Lake Neuchatel compared with 70% in oligotrophic lakes, 35% in mesotrophic lakes, and 0% in eutrophic lakes. The scarcity of oligotrophic species in the deepest area (153 m) characterized better the meso-eutrophic state of Lake Neuchatel than oxygen concentrations which never descended below 6 mg/L. Location of the area within the lake from where worms were sampled was of critical importance to assess the trophic state: some areas reflected the past rather than the present state of the lake. (Author's abstract)
W89-11414

EMERGENCE OF CHIRONOMIDAE (DIPTERA) FROM A DELTA-SWAMP RECEIVING THERMAL EFFLUENT.
Environmental and Chemical Sciences, Inc., Aiken, SC.
B. G. Coler, and B. C. Kondratieff.
Hydrobiologia HYDRB8, Vol. 174, No. 1, p 67-77, April 1989. 8 fig, 1 tab, 38 ref.

Descriptors: *Water pollution effects, *Wetlands, *Thermal pollution, *Midges, *Thermal stress, *Swamps, *Nuclear powerplants, Temperature effects, Dissolved oxygen, Ecological effects, Environmental effects.

Chironomid pupal exuviae were collected over an eight-week period from a delta-swamp which receives thermal effluent from a nuclear reactor on the Savannah River Plant, South Carolina. Two sites were sampled using box-type emergence traps. Site 1 was directly in a major thermal plume channel, and site 2 was outside the plume in a stand of stressed bald cypress trees. Sixteen chironomid taxa were collected, of these, species of Chironomus (42%) and Tanytarsus (35%) dominated the warmer site (site 1, maximum temperature 46 C), whereas Tanypus neopunctipennis comprised >84% at site 2 (maximum temperature 43 C). Emergence substantially increased at both sites after the reactor was shut down and water temperatures returned to ambient (27-28 C). Tanytarsus sp. 1 and T. neopunctipennis were capable of successfully emerging during water temperature periods of 40-46 C. The deep organic sediment, characteristic of the delta-swamp apparently served as a refugium for these and other species of midges during high temperature periods. It is suggested that the ability of some taxa to tolerate these elevated temperatures may be a combination of several factors: behavioral and ecological adaptations to utilize available refugia; and physiological adaptations to withstand higher temperatures and low dissolved oxygen concentrations. (Author's abstract)
W89-11415

NUTRIENT LOAD CARRIED BY THE RIVER PO INTO THE ADRIATIC SEA, 1968-87.
Milan Univ. (Italy). Ist. di Biologia.
For primary bibliographic entry see Field 5B.
W89-11417

SARGASSUM MUTICUM AND OTHER INTRODUCED JAPANESE MACROALGAE: BIOLOGICAL POLLUTION OF EUROPEAN COASTS.
Oslo Univ. (Norway). Dept. of Biology.
J. Rueness.
Marine Pollution Bulletin MPNBAZ, Vol. 20, No. 4, p 173-176, April 1989. 1 fig, 24 ref.

Descriptors: *Algae, *Fouling, *Eutrophication, *Introduced species, Norway, Oysters, Aquatic weeds, Ecological effects.

The first finds of attached populations of the Japanese brown seaweed Sargassum muticum are reported from Norway, and the rapid spread of this invasive species in Europe during the last 15 yr is discussed. The numerous air bladders of S. muticum make drifting fragments an effective means of long-range dispersal. The alga is monoecious and self-fertile, so that a single branch is capable of releasing numerous progeny. The perennating holdfast may regenerate shoots when fronds are lost by natural senescence, wave action, or ice-scouring. Other recent introductions of large brown algae caused by importation of Japanese oysters in mariculture include Undaria pinnatifida and Laminaria japonica. The ecological consequences of their spread are difficult to predict, but the changes they could bring about in the ecosystem are far more serious than the earlier well-known introductions of species belonging to the fouling community. Changes associated with introductions of this type of alien species and the possible competitive exclusion of indigenous species may have many indirect, system-level effects on the biota. The amount of ecological disturbance and the time before a stabilized phase is reached will vary for each particular case. Campaigns have been mounted to hinder the introduction of S. muticum and other fouling species from the Pacific into European waters. (Geiger-PTT)
W89-11418

COMMUNITY PARAMETERS AND MULTIVARIATE ANALYSIS AS A MEANS OF ASSESSING THE EFFECTS OF TANNERY EFFLUENTS ON MACROBENTHOS.
National Centre for Marine Research, Athens (Greece).
A. Zenetos, and E. Papathanassiou.
Marine Pollution Bulletin MPNBAZ, Vol. 20, No. 4, p 176-181, April 1989. 7 fig, 2 tab, 36 ref.

Descriptors: *Water pollution effects, *Benthos, *Tannery wastes, *Multivariate analysis, Species diversity, Spatial distribution, Aegean Sea, Species composition, Population dynamics.

Classification and ordination techniques were employed on the benthic communities of the gulf of Geras (Lesvos Island, Aegean Sea, Greece), as supplementary to conventional measures used (species composition, species diversity, abundance, community diversity and evenness) in order to assess the impact tannery effluents have on them. There is no evidence of contamination or disturbance of any sort, not even at stations near the tannery conductors as concluded from the above community parameters. Seasonal changes were apparent in species diversity and abundance, but they were of secondary importance to spatial changes, related to differences in sediment type. Both multivariate techniques applied, led to the same distributional pattern. That is, the station in the open sea and the station near the tannery conductor are separated from the others. At a lower level of similarity, a subgroup of stations is formed by the stations located at the narrow channel, while another subgroup is formed by the stations located in the inner part of the gulf. Since there is no sign of major disturbances in the benthic communities, the above grouping must be attributed to differences in sediment type, degree of isolation, depth and wave action. (Author's abstract)
W89-11419

CONCENTRATIONS OF DICHLORVOS IN BEIRTREACH BUI BAY, IRELAND.
Trinity Coll., Dublin (Ireland). Dept. of Zoology.
For primary bibliographic entry see Field 5B.
W89-11422

REGIONAL LAKE AND RESERVOIR CANONICAL ENVIRONMENTS.
Environmental Monitoring Systems Lab., Las Vegas, NV.
For primary bibliographic entry see Field 2H.
W89-11429

CLONED RAINBOW TROUT LIVER P(1)450 COMPLEMENTARY DNA AS A POTENTIAL ENVIRONMENTAL MONITOR.
Medical Coll. of Wisconsin, Inc., Milwaukee. Dept. of Pharmacology and Toxicology.
For primary bibliographic entry see Field 5A.
W89-11431

BIOTOP IMPAIRMENT CAUSED BY POTASSIUM POLLUTED WATER OF THE WERRA AND OBERWESER RIVERS (SCHADWIRKUNG DER KALI-ABWESSER IM BIOTOP DER WERRA UND OBERWESER).
G. Buhse.
Zeitschrift fuer Wasser-und Abwasser Forschung ZWABAQ, Vol. 22, No. 2, p 49-56, April 1989. 4 fig, 9 tab, 10 ref. English summary.

Descriptors: *Potassium, *Rivers, *Fishkill, *Water pollution effects, *Aquatic productivity, Diatoms, Fish, Aquatic bacteria, Salts, Waste disposal, Hardness, Ecological effects, Environmental effects.

The productivity of the Werra River as well as the Oberweser River, Germany were fairly good in their three and six regions, respectively. This was due to the high level of carbonate hardness, a moderate sapprobic level and an extremely low load of heavy metals. Since 1953, due to the extreme load of continuously potassium polluted water from the GDR, progressive impairments were observed which caused the depopulation of several stretches. The saltification in the Werra River is approximately 30 times higher than that of the Rhein River. This persistent pollution caused the extinction of many autochthonous biota. The development of diatoms increased exorthonous biota. The bacterial activity decreased considerably. The fecundity of fish and the growth of juveniles were both impaired, and fish diseases were increasing. The tolerance of fish to salts manifests itself according to the age and the species of individuals. Fishkills occurred but were not observed because the corpses decompose at the river bottom. It is approximated that the salt waste-water disposal is approximated to be 35 million tons/yr. The transport of this salt waste-water amount by rail would cost about 1100 million DM and the lost yield due to saltification comprises 65 million DM/yr. The solutions leading to a harmless waste disposal are known and successfully realized by the Kaliwerke in Hessen. (Author'sbstract)
W89-11432

DETERMINATION OF ORGANOPHOSPHOROUS COMPOUNDS AND CARBAMATES BY THEIR INHIBITION OF CHOLINESTERASE. PART 1: INHIBITION VALUES ON IMMOBILIZED CHOLINESTERASE (BESTIMMUNG VON PHOSPHORPESTIZIDEN UND INSEKTIZIDEN CARBAMATEN MITTELS CHOLINESTERASEHEMMUNG).
Technische Univ. Muenchen (Germany, F.R.). Inst. fuer Wasserchemie und Chemische Balneologie.
For primary bibliographic entry see Field 5A.
W89-11434

BIOTEST TO DETERMINE HERBICIDES IN WATER: METHODS AND FIRST RESULTS (BIOTEST ALS SUMMENPARAMETER ZUR BESTIMMUNG VON HERBIZIDEN IM WASSER: METHODISCHE GRUNDLAGEN).
Technische Univ. Muenchen (Germany, F.R.). Inst. fuer Wasserchemie und Chemische Balneologie.
For primary bibliographic entry see Field 5A.
W89-11435

HORIZONTAL DISTRIBUTION OF ROTIFER PLANKTON ALONG A TROPHIC GRADIENT IN LAKE BALATON: CHANGES OF COMMUNITY STRUCTURE AND ABUNDANCE DURING THE PAST 20 YEARS.
Balatoni Limnologiai Kutato Intezete, Tihany (Hungary).
For primary bibliographic entry see Field 2H.
W89-11446

ECOLOGICAL EFFECTS OF PENTACHLOROPHENOL ON THE BRACKISH-WATER AMPHIPOD GAMMARUS TIGRINUS.
Mount Allison Univ., Sackville (New Brunswick). Dept. of Biology.

W. G. Kierstead, and F. Barlocher.
Archiv fuer Hydrobiologie AHYBA4, Vol. 115, No. 1, p 149-156, March 1989. 4 fig, 22 ref.

Descriptors: *Water pollution effects, Physiological ecology, *Brackish water, *Gammarus, Pesticides, *Toxicity, *Amphipods, Physiology, Salinity, Contamination, Sublethal effects, Spawning, Food chains, Mortality.

In water with a salinity of 7.5 ppt, the pentachlorophenol (PCP) concentration required for 50% mortality of Gammarus tigrinus within four days was 371 microg/L. Sublethal concentrations of PCP increased the tissue respiration rate of G. tigrinus. However, this effect was less pronounced at a salinity of 29 ppt. Because respiration becomes less efficient, growth and reproduction usually decline at sublethal exposure to PCP. Prolonged exposure to low PCP concentration reduced the caloric content of animals kept in low salinity water. Persistent sublethal contamination with PCP can be expected to lower energy accumulation in G. tigrinus. This will undoubtedly lower its ability to reproduce successfully, leading to declining populations, and maybe eventually to its extinction in a contaminated environment. In addition, it may no longer be able to fulfill its function in the food web. Its decline in numbers, and its lower caloric content, will adversely affect upper trophic levels. (White-Reimer-PTT)
W89-11449

HOME SHOWER-BATH PSEUDOMONAS FOLLICULITIS.
Rogoff-Wellcome Medical Research Inst., Petach Tikva (Israel). Dept. of Internal Medicine.
D. Huminer, C. Block, H. Shmuely, and S. D. Pitlik.
Israeli Journal of Medical Sciences IJMDAI, Vol. 25, No. 1, p 44-45, 1989. 14 ref.

Descriptors: *Pseudomonas, *Public health, *Pathogenic bacteria, *Pathogens, *Human diseases, Contamination, Water pollution, Pseudomonas folliculitis, Infection, Swimming pools, Human pathology.

Pseudomonas folliculitis is a newly described skin rash that characteristically occurs in persons who bathe in contaminated water. It is characterized by follicular maculopapular, pustular and/or vesicular skin lesions distributed predominantly over the lateral aspects of the trunk, on the axillae, buttocks and proximal parts of the extremeties. The mean incubation period is 48 h following exposure to contaminated water. Most outbreaks have been associated with the use of public hot-tubs, and whirlpools and swimming pools (mainly in hotels, motels, and health spas). Less frequently, the infection has also been contracted in a public sauna, a public waterslide, a home whirlpool, and a physiotherapy pool. It is suggested that home shower-baths should be added to the list of potential sources of Pseudomonas folliculitis. The growth of Pseudomonas may be encouraged by exessive water temperature, and a water supply system has been reported to be a source of Pseudomonas. (White-Reimer-PTT)
W89-11462

TOLERANCE OF OXYGEN DEFICIT BY ELVERS (ANGUILLA ANGUILLA L.) (TOLERANCE AU DEFICIT D'OXYGENE CHEZ LA CIVELLE (ANGUILLA ANGUILLA L.)).
Ecole Nationale Superieure Agronomique de Toulouse (France). Lab. d'Ichthyologie Appliquee.
M. Wozniewski.
Roczniki Nauk Rolniczych, 3eria H: Rybactwo RNRRB9, Vol. 101, No. 4, p 177-182, 1988. 2 fig, 12 ref. English summary.

Descriptors: *Water pollution effects, *Oxygen deficit, *Oxygen requirements, *Mortality, *Eel, Fish, Water temperature, Garonne River, France, Growth stages, Juvenile growth stage.

The oxygen tolerance of elvers (Anguilla anguilla) from the Garonne River, France was examined. The oxygen level causing 50% mortality was 1.18 mg O2/L during a 24-h test carried out at 20 C water temperature. These results are comparable to those previously reported for the tench. (Author's abstract)
W89-11501

DETECTION OF PILUSLIKE STRUCTURES ON CLINICAL AND ENVIRONMENTAL ISOLATES OF VIBRIO VULNIFICUS.
Texas Univ. Medical School at Houston.
R. M. Gander, and M. T. LaRocco.
Journal of Clinical Microbiology JCMIDW, Vol. 27, No. 5, p 1015-1021, May 1989. 2 fig, 3 tab, 38 ref.

Descriptors: *Vibrio, *Bacterial physiology, *Epidemiology, Bacteria, Pathogenic bacteria, Isolation, Microbiological studies, Microscopic analysis, Bacterial analysis, Chemical composition, Sugars.

Vibrio vulnificus causes serious, sometimes fatal, infections in humans. Primary septicemias, with a mortality of 50%, develop after ingestion of contaminated seafood, especially raw oysters. Twenty clinical isolates of Vibrio vulnificus were compared with 10 environmental strains by using electron microscopy and agglutination assays with human erythrocytes, guinea pig erythrocytes, and Saccharomyces cerevisiae. In addition, the isolates were tested for ability to adhere to the human epithelial cell lines HEp-2 and A549. When examined by electron microscopy, 16 (80%) of the 20 clinical isolates demonstrated the presence of pilus-like structures; the composition of the bacterial populations ranged from 0 to 68% piliated cells. In contrast, only 3 (30%) of the 10 environmental isolates were piliated, with a range from 0 to 16% piliated cells. Multiple patterns of adherence inhibition were observed. Adherence to A549 cells showed 8 (40%) of 20 clinical isolates and 0 (0%) of 10 environmental strains with averages of > 10 adherent bacteria per cell. A statistical association between attachment and the isolate source was demonstrated ($P < 0.05$). These data suggest that the presence of pilus-like structures and the ability to adhere to human epithelial cell lines may be more closely associated with V. vulnificus isolates from clinical specimens than with environmental strains. (Dcria-PTT)
W89-11502

VIABILITY OF GIARDIA CYSTS SUSPENDED IN LAKE, RIVER, AND TAP WATER.
Minnesota Univ., Minneapolis. Dept. of Lab. Medicine.
D. P. deRegnier, L. Cole, D. G. Schupp, and S. L. Erlandsen.
Applied and Environmental Microbiology AEMIDF, Vol. 55, No. 5, p 1223-1229, May 1989. 5 fig, 1 tab, 36 ref. US EPA Cooperative Agreement CR-814622.

Descriptors: *Human diseases, *Giardia, *Fate of pollutants, *Path of pollutants, *Protozoa, *Survival, *Epidemiology, *Parasites, *Water pollution effects, Lakes, Rivers, Drinking water, Water temperature, Monitoring, Dissolved oxygen, Acidity, Feces, Distilled water, Temperature effects.

The viability of Giardia muris cysts suspended in lake, river, and tap water were studied while monitoring water temperatures, dissolved oxygen, pH, and other water quality parameters. Fecal pellets containing G. muris cysts were placed in glass vials covered with filter paper and exposed to (1) lake water at 15 ft and 30 ft, (2) river water, (3) tap water, and (4) distilled water stored under laboratory conditions. In the fall, the cysts suspended at 30 ft in lake water remained viable for up to 56 days whereas cysts stored at 15 ft were nonviable after day 28. The G. muris cysts exposed to river water remained viable up to 28 days as determined by the production of giardiasis in mice. G. muris cysts suspended in tap water showed no signs of viability after 14 days, while cysts serving as controls (exposed to refrigerated distilled water) remained viable for up to 56 days. In the winter, Giardia cysts suspended in either lake or river water were viable for 56 to 84 days whereas cysts exposed to tap water were nonviable by day 14. Comparison of water quality parameters with the results of viability determination revealed that only decreased water temperature (< 10 C) was consistent with prolonged survival of G. muris in different types of environmental water. (Author's abstract)
W89-11510

RESPONSE OF WHITE CLOVER (TRIFOLIUM REPENS L.) AND RYEGRASS (LOLIUM PERENNE L.) TO ACID RAIN IN SITUATIONS OF SPECIES INTERFERENCES.
Institute of Terrestrial Ecology, Bangor (Wales). Bangor Research Station.
L. Menchaca, and M. Hornung.
New Phytologist NEPHAV, Vol. 111, No. 3, p 483-489, March 1989. 3 fig, 4 tab, 16 ref.

Descriptors: *Acid rain effects, *Clovers, *Grasses, *Crop yield, Sulfuric acid, Water pollution effects, Population density, Model studies, Canopy, Spatial distribution, Temporal distribution.

Pure stands of Trifolium repens L. N.Z. Huia and Lolium perenne L. S32 and mixtures of various densities and frequencies were treated with sulfuric acid solutions of pH 2.5, 3.5, and 5.6. The species yield was recorded over five sequential harvests. Multifactorial response equations were used to describe the behavior of the species yield as a function of acidity and the density of both species. Predictions, made through these models, showed that the response of yield of these species to simulated acid rain treatments varied greatly depending on the planting density, the time of harvesting, and on whether the plants were growing in monoculture or in mixture. This suggests that it is not sufficient to consider the effects of experimentally applied acid rain on single individuals or low density stands, since the results obtained will not reflect the response in a close canopy sward. In field conditions, this complexity will be even greater as a result of (1) complex rainfall-canopy interactions, (2) variation in precipitation chemistry and synergistic effects of these chemicals, and (3) spatial and temporal variations in soil conditions. Models such as those presented here may, however, be of value in simplifying the description of the response of plants to complex interactions between pollutants and other environmental factors especially in cases where greater complexity than is possible in most controlled dose-response experiments required to simulate more closely field conditions. (Author's abstract)
W89-11527

SENSITIVITY OF FOREST PLANT REPRODUCTION TO LONG-RANGE TRANSPORTED AIR POLLUTANTS: THE EFFECTS OF WET DEPOSITED ACIDITY AND COPPER ON REPRODUCTION OF POPULUS TREMULOIDES.
Maritimes Forest Research Centre, Fredericton (New Brunswick).
R. M. Cox.
New Phytologist NEPHAV, Vol. 110, No. 1, p 33-38, September 1988. 2 fig, 3 tab, 36 ref. Canadian Forestry Service-Maritimes Contract OS082-00289.

Descriptors: *Air pollution effects, *Forests, *Germination, *Acid rain effects, *Copper, Trees, Pollen, Acidity, Simulated rainfall.

Few, if any, studies have been carried out that examine and relate in vivo pollen germination following simulated wet deposition of acidity and copper with various fruit and seed set parameters of trees. The methods used with inflorescences of a wind-pollinated tree, Populus tremuloides, are reported here. The effect of simulated rain at the time of pollination was shown to increase fruit abortion significantly. In addition, an overall significant negative correlation was found between fruit abortion and pH but, in the absence of copper, fruit abortion recovered at the lowest pH (2.6). Seeds per fruit and percentage of placenta with full seeds were significantly reduced at pH 2.6 in the presence of 0.05 mg/l Cu compared with the control. These two seed set parameters were also significantly intercorrelated ($P < 0.01$) with fruit abortion suggesting that lack of seed set may be

the cause of the abortion. The significant correlation of both in vivo pollen germination and fruit abortion with pH, especially in the presence of copper, supports the view that inhibition of the pollen on the stigma by the simulated rain is responsible for the lack of seed set above the required threshold that prevents fruit abortion. (Author's abstract)
W89-11528

EFFECTS OF SOURCE AND DESTINATION ON GROWTH AND METAL UPTAKE IN FRESHWATER CLAMS RECIPROCALLY TRANSPLANTED AMONG SOUTH CENTRAL ONTARIO LAKES,
University of Western Ontario, London. Dept. of Zoology.
S. G. Hinch, and R. H. Green.
Canadian Journal of Zoology CJZOAG, Vol. 67, No. 4, p 855-863, April 1989. 4 fig, 6 tab, 52 ref.

Descriptors: *Ontario, *Lakes, *Alkalinity, *Water pollution effects, *Clams, *Heavy metals, *Bioaccumulation, *Growth rates, Aquatic populations, Aquatic habitats, Mollusks, Trace elements, Copper, Zinc, Manganese, Cadmium, Aquatic animals, Bioindicators.

The relative contributions of genotype and environment to growth and metal uptake in freshwater unionid clams (Elliptio complanata) were evaluated using a reciprocal transplant experiment. In August 1985, comparable sites were selected in three south central Ontario lakes with alkalinities of 22, 153, and 238 microequiv/L. Shell length, height, and width varied in a manner that could not be related to lake alkalinities. There were differences among the clam populations in allelic frequencies (at the Pgm and Lap-2 loci). Clams were marked, measured, and reciprocally transplanted among the three lakes. In August 1986, marked individuals were recovered, remeasured, and analyzed for levels of Cu, Zn, Mn and Cd in soft tissues. The transplant source had a strong influence on clam growth during the post-transplant year. This source effect may result from genetic differences among the populations. Tissue metal concentrations at the end of the post-transplant year were a function of both source and destination. The use of freshwater clams as transplant biomonitors must be reassessed since there is a strong source component to growth and metal uptake. In transplant experiments, a common source (a particular site within a particular lake) should be used, and post-transplant periods of more than 1 year may be necessary for the influence of the destination environment to dominate the influence of the source environment. (Author's abstract)
W89-11541

EFFECTS OF COPPER ON SPECIES COMPOSITION OF BENTHIC INSECTS IN A SIERRA NEVADA, CALIFORNIA, STREAM.
Geological Survey, Menlo Park, CA. Water Resources Div.
H. V. Leland, S. V. Fend, T. L. Dudley, and J. L. Carter.
Freshwater Biology FWBLAB, Vol. 21, No. 2, p 163-179, April 1989. 2 fig, 3 tab, 45 ref.

Descriptors: *Species composition, *California, *Stream biota, *Water pollution effects, *Copper, *Benthic fauna, *Aquatic insects, Population exposure, Stream pollution, Population dynamics, Heavy metals, Trace elements, Trophic level, Aquatic environment, Species diversity, Productivity, Oligotrophy.

Effects of copper on species composition and production of benthic insects in an oligotrophic stream dosed at low concentrations (2.5-15 micrograms/l Cu sub T; approximately 12-75 ng/l Cu(2+)) were determined. Dosing was initially in autumn-early winter when peak densities of many species occur. It was resumed the following summer near the time of egg hatch of most species and continued through the remaining aquatic stages of univoltine and multivoltine taxa. Declines in population density of species representing all major orders (Ephemeroptera, Plecoptera, Coleoptea, Trichoptera, and Diptera) occurred at 5 and/or 10 micrograms/l Cu sub T. Differences in sensitivity among families existed in the Plecoptera, Trichoptera and Diptera. These differences were apparently related to the trophic preferences of taxa, with herbivores and detritivores more sensitive than predators. Equivalent percentage declines in annual production occurred for herbivores/detritivores and predators exposed to copper, suggesting an adjustment in total predator production in response to the reduction in prey abundance. Possible examples of release of benthic insects from competition with less tolerant species were rare. Of the thirty-seven most abundant taxa, only the predators Rhyacophila vaccua and Rhyacophila angelita were more abundant (than in the control) at copper concentrations (5 and 10 micrograms/l Cu sub I) causing population declines of other species. Species richness and percentage similarity were sensitive community-level indices of copper toxicity, whereas Brillouin's diversity was insensitive to differences among the control and copper-treated stream sections. (Author's abstract)
W89-11544

EFFECT OF NONPOINT POLLUTANT SOURCES ON WATER QUALITY OF STREAMS IN PUSAN CITY.
W. J. Choi, and C. K. Park.
Bulletin of National Fisheries University of Pusan, Vol. 28, No. 2, p 15-21, December 1989. 6 fig, 3 tab, 14 ref. English summary.

Descriptors: *Water pollution effects, *Water quality, *Urban hydrology, *Nonpoint pollution sources, *Korea, *Rainfall-runoff relationships, Storm runoff, Biochemical oxygen demand, Suspended solids, Nitrogen, Phosphates, Pollution load, Project planning.

This study was performed to evaluate the effects of nonpoint pollutant sources on water quality of streams of Dong-Cheon and Daeyeon-Cheon in Pusan city, Korea from June, 1985 to August, 1985. Average concentrations of BOD, suspended solids, total inorganic nitrogen, and phosphate phosphorus during the wet weather were about 1.1 to 7.8 times higher than those of the dry weather, and the highest concentrations of these pollutants were found following the first flush of rain. Sixty-three to eighty percent of the suspended solids associated with runoff settled out within 20 minutes. The mass loading of BOD, total suspended solids, total inorganic nitrogen and phosphate phosphorus were estimated to be 60 ton/sq km/y, 235.0 ton/sq km/y, 7.2 ton/sq km/y and 0.9 ton/sq km/y, respectively, during the wet weather. The large amount of pollutants from nonpoint sources during wet weather adversely affect the water quality of the bays and rivers. Therefore, it is necessary to consider the loading of nonpoint sources of pollutants for planning sewage treatment plants. (Author's abstract)
W89-11606

BIOLOGICAL IMPOVERISHMENT IN LAKES OF THE MIDWESTERN AND NORTHEASTERN UNITED STATES FROM ACID RAIN.
Department of Fisheries and Oceans, Winnipeg (Manitoba). Freshwater Inst.
D. W. Schindler, S. E. M. Kasian, and R. H. Hesslein.
Environmental Science and Technology ESTHAG, Vol. 23, No. 5, p 573-580, May 1989. 2 fig, 7 tab, 59 ref.

Descriptors: *Model studies, *Acid rain, *Lakes, Calcium, Magnesium, Hydrogen ion concentration, Organic carbon, Environmental effects, Fish, Tolerance, Neutralization, Invertebrates.

A model based on relationships between Ca + Mg, acid-neutralizing capacity, pH, and dissolved organic carbon was used to predict the changes in the pH of acid-sensitive lakes (Ca + Mg < 200 microequiv/L) in the northeastern and midwestern United States, using the U.S. EPA's Eastern Lake Survey data base. A second model, relating estimated pH changes to the pH tolerances of aquatic taxa, was used to predict the degree of biotic impoverishment caused by acid precipitation. The largest predicted declines in median pH were 0.6 unit in the Adirondacks and 0.7 unit in the Poconos/Catskills. This change would result in the elimination of 40-70% of acid-sensitive taxa such as leeches, mollusks, and insects. In addition, lower but significant damage to cyprinids, centrarchids, and salmonids is indicated. Intermediate pH declines and biological losses were predicted for Southern and Central New England, with detectable damage indicated for Upper Michigan and North Central Wisconsin. Little or no damage was detected in Maine, Northeastern Minnesota, and the Upper Great Lakes. (Author's abstract)
W89-11621

DISSOLVED OXYGEN DYNAMICS IN THE MID-PASSAIC RIVER: MATHEMATICAL MODEL.
Cook Coll., New Brunswick, NJ. Dept. of Environmental Science.
For primary bibliographic entry see Field 5B.
W89-11642

JOINT ACTION OF AMMONIA AND NITRITE ON ARTEMIA NAUPLII.
National Taiwan Coll. of Marine Science and Technology, Keelung. Dept. of Aquaculture.
J. Chen, K. Chen, and J. Liao.
Aquaculture AQCLAL, Vol. 77, No. 4, p 329-336, April 1989. 4 fig, 3 tab 19 ref.

Descriptors: *Larval growth stage, Synergistic effects, *Fish hatcheries, *Ammonia, *Brine shrimp, *Water pollution effects, *Nitrites, *Toxicity, Sublethal effects, Biochemistry, Aquatic animals, Population exposure, Crustaceans, Median tolerance limit.

Newly hatched Artemia nauplii were exposed to ammonia, nitrite, and different ratios of ammonia and nitrite, employing the static renewal method. The 24-h LC50 concentrations were 839.5 mg/l for TAN (total ammonia nitrogen), 14.17 mg/l for FAN (free ammonia nitrogen) and 1609.7 mg/l for nitrite-N. The corresponding 48 h LC50 concentrations were 334.7 mg/l for TAN, 5.65 mg/l for FAN and 1141.0 mg/l for nitrite-N. When the toxicity ratio of the ammonia-nitrite mixture was 1:1, equivalent 24-h LC50 concentrations were 252.3 mg/l for TAN, 4.26 mg/l for FAN and 928.4 mg/l for nitrite-N, while the 48-h LC50 concentrations were 106.3 mg/l for TAN, 1.80 mg/l for FAN and 362.3 for nitrite-N. At a toxicity ratio of 2:1 for ammonia-nitrite mixtures, the 24-h and 48-h LC50 concentrations were 305.2 and 162.3 mg/l for TAN, 5.15 and 2.74 mg/l for FAN and 500.8 and 266.2 mg/l for nitrite-N, respectively. In mixtures, ammonia and nitrite exhibited a synergistic effect on the Artemia nauplii after 48-h exposure. (Author's abstract)
W89-11644

EFFECT OF VEGETABLE OIL FACTORY EFFLUENT ON THE GONADS OF A FRESHWATER TELEOST, HETEROPNEUSTES FOSSILIS (BL.)--A BIOCHEMICAL STUDY.
Punjab Agricultural Univ., Ludhiana (India). Dept. of Zoology.
J. K. Kondal, P. K. Saxena, and G. L. Soni.
Environmental Pollution ENPOEK, Vol. 57, No. 2, p 117-125, 1989. 3 tab, 23 ref.

Descriptors: *Food-processing wastes, *Oil wastes, *Spawning, *Sublethal effects, *Fish physiology, *Organic wastes, *Water pollution effects, Population exposure, Biochemistry, Liquid wastes, Effluents, Chemical wastes, Aquatic animals, Metabolism, Lipids, Fatty acids.

The effects of three sublethal concentrations (5, 10, 15 percent v/v) of vegetable oil factory effluent on biochemical changes in the gonads (ovaries/testes) of a freshwater teleost were studied. The results reveal a significant decline in the total lipid, cholesterol, phospholipid, and glyceride levels, but an increase in the free fatty acid levels both in the ovaries and testes of H. fossilis, following 150 days (mid-January through mid-June) of exposure to 10 percent and 15 percent concentrations of the efflu-

ent. This decrease/increase in the biochemical parameters was more or less dependent on the concentration of the effluent. The type of decline in the total lipids of the ovaries/testes observed in effluent-exposed fish in this study has been associated with inhibition of the lipid synthesis, and/or comparatively greater utilization of the stored lipids, and also with the low occurrence of the vitellogenic and yolky oocytes of the ovaries. However, it is also associated with the loss of spermatogenetic cells in the tests. (Friedmann-FTT)
W89-11648

REPRODUCTIVE IMPAIRMENT IN A FISH INHABITING A CONTAMINATED COASTAL ENVIRONMENT OFF SOUTHERN CALIFORNIA.
Occidental Coll., Los Angeles, CA. Dept. of Biology.
J. E. Hose, J. N. Cross, S. G. Smith, and D. Diehl.
Environmental Pollution ENPOEK, Vol. 57, No. 2, p 139-148, 1989. 2 fig, 1 tab, 43 ref. NOAA Grant NA-85-ABD-00003.

Descriptors: *Water pollution effects, *Fertility, *Spawning, *Coastal waters, *Fish populations, Population exposure, Fish behavior, Sublethal effect, DDT.

White croaker (Genyonemus lineatus), collected from a highly contaminated site in San Pedro Bay and from a reference site 80 km away (Dana Point), were induced to spawn in the laboratory. Forty-one percent of San Pedro Bay females and 54 percent of Dana Point females spawned. Examination of the ovaries of non-spawning females revealed that spawning was imminent in the remainder of Dana Point fish but only in 16 percent of the San Pedro Bay fish. The remainder of the San Pedro Bay fish (43 percent) contained only immature, yolky oocytes. No croakers containing more than 3-8 ppm ovarian total DDT could be induced to spawn whereas 36 percent of a contemporaneous San Pedro Bay sample had ovarian total DDT residues in excess of 4 ppm. This suggests that the inability to induce spawning in white croaker may be associated with an ovarian total DDT threshold of about 4 ppm. These data, coupled with observed decreases in fecundity (32 percent), fertility (14 percent), and early oocyte loss (30 percent) relative to reference fish, could partially explain the population declines observed for many southern California fishes since the 1940s. (Author's abstract)
W89-11649

ACIDITY STATUS AND PHYTOPLANKTON SPECIES RICHNESS, STANDING CROP, AND COMMUNITY COMPOSITION IN ADIRONDACK, NEW YORK, U.S.A. LAKES.
New York State Museum, Albany. Science Service Div.
C. A. Siegfried, J. A. Bloomfield, and J. W. Sutherland.
Hydrobiologia HYDRB8, Vol. 175, No. 1, p 13-32, April 29 1989. 8 fig, 7 tab, 34 ref.

Descriptors: *Species composition, *New York, *Acid rain effects, *Standing crops, *Species diversity, *Acidic water, *Adirondack Mountains, *Phytoplankton, *Hydrogen ion concentration, *Mountain lakes, Lakes, Physico chemical properties, Aquatic habitats, Chlorophyll, Biomass, Aquatic plants, Ecosystems, Dinoflagellates, Chlorophyta, Chrysophyta.

The mid-summer phytoplankton communities of more than 100 Adirondack lakes ranging in pH from 4.0 to 7.2 were characterized in relation to 25 physical-chemical parameters. Phytoplankton species richness declined significantly with increasing acidity. Acidic lakes (pH < 5.0) averaged fewer than 20 species while more circumneutral waters (pH > 5.5) averaged more than 33 species. Phytoplankton abundance was not significantly correlated with any of the measured physical-chemical parameters, but standing crop parameters, i.e., chlorophyll a and phytoplankton biovolume, did correlate significantly with several parameters. Midsummer standing crop correlated best with total phosphorus concentration but acidity status affected the standing crop-phosphorus relationship. Circumneutral waters of low phosphorus content, i.e. < 10 micrograms/l TP, averaged 3.62 micrograms/l chlorophyll a whereas acidic lakes of the same phosphorus content averaged only 1.96 micrograms/l chlorophyll a. The midsummer chlorophyll content of lakes of high phosphorus content, i.e. > 10 micrograms/l TP, was not significantly affected by acidity status. Adirondack phytoplankton community composition changes with increasing acidity. Such communities, in midsummer, can be classed into one of four types: (1) depauperate clear water acid lake assemblages dominated by dinoflagellates, (2) the more diverse oligotrophic acid lake communities, (3) the productive acid lake communities dominated by green algae, and (4) the chrysophyte dominated community. (See also W89-11654) (Author's abstract)
W89-11653

PLANKTONIC ROTIFER COMMUNITY STRUCTURE IN ADIRONDACK, NEW YORK, U.S.A. LAKES IN RELATION TO ACIDITY, TROPHIC STATUS AND RELATED WATER QUALITY CHARACTERISTICS.
New York State Museum, Albany. Science Service Div.
C. A. Siegfried, J. A. Bloomfield, and J. W. Sutherland.
Hydrobiologia HYDRB8, Vol. 175, No. 1, p 33-48, April 29 1989. 6 fig, 9 tab, 27 ref.

Descriptors: *Water quality, *Adirondack Mountains, *Zooplankton, *Species composition, *New York, *Acid rain effects, *Acidic water, *Rotifers, *Hydrogen ion concentration, *Mountain lakes, *Trophic level, Species diversity, Aquatic populations, Population density, Aquatic habitats, Biomass, Lakes, Alkaline water, Ecosystems.

The structure of midsummer planktonic rotifer communities of 101 Adirondack lakes ranging in pH from 4.0 to 7.3 were characterized in relation to acidity and selected water quality parameters. More than 70 rotifer species were identified from collections in 1982 and 1984. None of the species collected could be considered acidobiontic or alkalibiontic. Keratella taurocephala was the most commonly collected rotifer, occurring in 94 of the study lakes. It was abundant throughout the range of pH investigated, but was particularly dominant in acidic waters, averaging > 85 percent of the rotifers collected from waters of pH < 5.0. Rotifer community structure can be related to three groups of water quality parameters. Community parameters (richness and diversity) are most highly correlated with parameters indicative of acidity status. Rotifer abundance correlates with tropic state indicators, i.e., chlorophyll a and total phosphorus, over the full range of pH investigated. However, in acidic lakes, rotifer abundance is related to true color and DOC, indicators of humic influences. The rotifer communities of the Adirondacks can be classified into four broad types: (1) diverse, productive, more alkaline lakes of about 13 species, dominated by Conochilus unicornis, Kellicottia bostoniensis, Kellicottia longispina, and Polyarthra major; (2) productive, diverse, highly colored acid lakes, with about 8 species, often with very large populations (> 200/l), dominated by K. bostoniensis and K. taurocephala; (3) Depauperate (< 4 species) communities of clear water acid lakes, with low density populations dominated by K. taurocephala, and (4) extremely depauperate (2-3 species) acid lake communities with high flushing rates, dominated by C. unicornis. (See also W89-11653) (Author's abstract)
W89-11654

CHRONIC TOXICITY OF CADMIUM TO CHIRONOMUS RIPARIUS MEIGEN--EFFECTS UPON LARVAL DEVELOPMENT AND ADULT EMERGENCE.
University of Wales Inst. of Science and Technology, Cardiff. Dept. of Applied Biology.
D. Pascoe, K. A. Williams, and D. W. J. Green.
Hydrobiologia HYDRB8, Vol. 175, No. 2, p 109-115, May 8 1989. 5 fig, 4 tab, 22 ref. EEC Contract ENV.773.UK.H.

Descriptors: *Midges, *Water pollution effects, *Toxicity, *Cadmium, *Heavy metals, *Sublethal effects, Growth stages, Larvae, Mortality, Morbidity, Larval growth stage, Population exposure, Life cycles.

Chronic cadmium toxicity tests were carried out with Chironomus riparius Meigen using a static-with-replacement exposure procedure. Significant reduction in larval development, survival and production were detected at 0.15 mg/l Cd, a value approximately 5000 times lower than the 48 h LC50 for fourth instar larvae. The first instar appears to be the most critical stage in terms of sensitivity, with the number of adults eventually emerging reflecting first instar mortality. Male emergence was slightly delayed at 0.15 mg/l Cd. The results of this study illustrate the importance of chronic toxicity tests in identifying sensitive life cycle stages and explaining pollutant-induced stress. (Author's abstract)
W89-11659

DYNAMICS OF FECAL COLIFORM AND CULTURABLE HETEROTROPH DENSITIES IN AN EUTROPHIC ECOSYSTEM: STABILITY OF MODELS AND EVOLUTION OF THESE BACTERIAL GROUPS.
Montpellier-2 Univ. (France). Lab. d'Hydrobiologie Marine.
For primary bibliographic entry see Field 2H.
W89-11663

TOXICITY OF ORGANOTINS TOWARDS THE MARINE YEAST DEBARYOMYCES HANSENII.
Dundee Univ. (Scotland). Dept. of Biological Sciences.
O. S. Laurence, J. J. Cooney, and G. M. Gadd.
Microbial Ecology MCBEBU, Vol. 17, No. 3, p 275-285, 1989. 5 fig, 47 ref.

Descriptors: *Organotins, *Marine environment, *Pesticides, *Toxicity, *Water pollution effects, *Yeasts, Population exposure, Trace elements, Growth rates, Biochemistry, Sensitivity analysis, Chlorides, Metabolism.

Of nine organotin compounds tested toward the marine yeast Debaryomyces hansenii, only triphenyltin chloride (Ph3SnCl) and mono, di, and tributyltin chloride induced significant K(+) release from cells, which was symptomatic of viability loss. The general order of toxicity of the butylated compounds was tributyltin chloride (Bu3SnCl) > monobutyltin chloride (BuSnCl3) >> dibutyltin chloride (Bu2SnCl2). The overall toxicity of Ph3SnCl was similar to BuSnCl3. Release of K(+) induced by butylated tin compounds or by Ph3SnCl was strongly dependent on the external pH. Maximal toxicity occurred at pH 6.5 for Bu3SnCl, BuSnCl3, and Ph3SnCl, whereas maximal toxicity of Bu2SnCl2 occurred at pH 5.0. Toxicity was decreased above or below these values. The toxicity of BuSnCl3, Bu3SnCl, and Ph3SnCl was reduced at salinity levels approximating seawater conditions. Prior growth of D. hansenii in 3 percent (w/v) NaCl also resulted in reduced sensitivity to Bu3SnCl as evidenced by a decreased rate and extent of K(+) efflux. Bu3SnCl-induced Na(+) release from cells grown in the absence or presence of 3 percent (w/v) NaCl was low and similar in both cases. It appeared that the monovalent cation was important in the reduction of Bu3SnCl toxicity since Na2SO4 had similar protective effect as NaCl while CsCl completely prevented K(+) efflux. Thus, the effects of external NaCl were related both to Na(+) and to Cl(-). These results emphasize that cellular and environmental factors influence the toxic effects of organotins and suggests that these compounds may be more effective antimicrobial agents in some environmental niches than in others. (Author's abstract)
W89-11666

ESTIMATING THE BURDEN OF ILLNESS IN AN ONTARIO COMMUNITY WITH UN-

TREATED DRINKING WATER AND SEWAGE DISPOSAL PROBLEMS.
McMaster Univ., Hamilton (Ontario). Dept. of Clinical Epidemiology and Biostatistics.
L. W. Chambers, F. Shimoda, S. D. Walter, L. Pickard, and B. Hunter.
Canadian Journal of Public Health CJPEA4, Vol. 80, No. 2, p 142-148, March/April 1989. 5 tab, 13 ref.

Descriptors: *Water pollution effects, *Human diseases, *Public health, *Drinking water, *Water supply, *Water quality standards, Municipal water, Potable water, Environmental policy, Water policy, Wastewater disposal, Economic aspects, Water conveyance.

The Hamilton-Wentworth Regional Health Department was asked by one of its municipalities to determine whether the present water supply and sewage disposal methods used in a community without piped water and regional sewage disposal posed a threat to the health of its residents. Three approaches were used: assessments by public health inspectors of all households; bacteriological and chemical analyses of water samples; and completion of a specially designed questionnaire by resident in the target community and a control community. Eighty-nine percent of the 227 residences in the target community were found to have a drinking water supply that, according to the Ministry of Environment guidelines, was unsafe and/or unsatisfactory. According to on-site inspections, 32 percent of households has sewage disposal problems. Responses to the questionnaire revealed that the target community residents reported more symptoms associated with enteric infections due to the water supply. Two of these symptoms, diarrhea and stomach cramps, had a relative risk of 2.2 when compared to the control community ($p < 0.05$). The study was successfully used by the municipality to argue for provincial funding of piped water. (Author's abstract)
W89-11670

MORPHOMETRIC STUDY OF THE EFFECTS OF TRIBUTYLTIN COMPOUNDS ON THE GILLS OF THE MUMMICHOG, FUNDULUS HETEROCLITUS,
Maryland Univ., Solomons. Center for Environmental and Estuarine Studies.
A. E. Pinkney, D. A. Wright, and G. M. Hughes.
Journal of Fish Biology JFIBA9, Vol. 34, No. 5, p 665-677, 1989. 3 fig, 6 tab, 30 ref.

Descriptors: *Animal morphology, *Organotins, *Killifish, *Pesticides, *Water pollution effects, *Gills, *Fish physiology, Animal pathology, Population exposure, Toxicity, Morbidity, Fish populations, Sublethal effects, Organic compounds.

The effects of tributyltin 9TBT) compounds on gill morphology were examined in the mummichog, Fundulus heteroclitus, in 96-h LC 50 and 6-wk sublethal exposures. Morphometry was used for the identification and quantification of effects with the light microscope. A 96-h LC50 of 17.2 micrograms/l was determined. Morphometric analysis of gill tissues revealed hypertrophy of the lamellar epithelium in fish exposed to 17.2 micrograms/l. Relative diffusing capacity was significantly decreased (-41 percent); ($p < 0.05$, ANOVA, Bonferroni t-test). At 35.6 micrograms/l, TBT exposure resulted in a significant reduction (-40 percent) in volume of the lamellar blood channels. Both of these observations occurred in fish that showed signs of acute poisoning, including loss of equilibrium. In fish exposed to sublethal concentrations of 0.105-2.000 micrograms TBT/l for 6 wk, there were no pathological changes in the gill. There were no treatment-related changes in the surface morphology of the gills of fish from both experiments upon scanning electron microscope examination. Although gill pathology was observed in acutely toxic exposure, it does not appear to be a major mechanism of TBT toxicity. (Author's abstract)
W89-11673

DIFFERENCES IN THE SENSITIVITY OF BROWN TROUT, SALMO TRUTTA L., AND RAINBOW TROUT, SALMO GAIRDNERI RICHARDSON, TO PHYSIOLOGICAL DOSES OF CORTISOL.
Freshwater Biological Association, Windermere (England).
A. D. Pickering, T. G. Pottinger, and J. F. Carragher.
Journal of Fish Biology JFIBA9, Vol. 34, No. 5, p 757-768, 1989. 4 fig, 1 tab, 42 ref.

Descriptors: *Fish physiology, *Steroids, *Environmental effects, *Dose-response relationships, *Trout, *Water pollution effects, *Sublethal effects, Morbidity, Mortality, Stress, Fish populations, Population exposure.

Salmonid fish are sensitive to many forms of environmental stress and respond by increasing the rate of secretion of cortisol, the predominant corticosteroid in teleost fish. However, prolonged elevation of blood cortisol levels has been shown to predispose some species of salmonid fish to infectious diseases, an effect almost certainly mediated by the suppressive action of corticosteroids on the fish's defense systems. There is now an accumulating body of evidence linking various forms of stress to a subsequent increase in the susceptibility of fish to a wide range of infectious diseases. Interspecific differences in the stress response of fish may be due, in part, to differences in the sensitivity of target tissues to cortisol. The relative response of brown and rainbow trout to a standardized dose of cortisol was assessed by monitoring condition (K factor), the number of circulating lymphocytes and mortality due to disease, following cortisol treatment. Cortisol implantation resulted in a significant decline in K factor and number of circulating lymphocytes in immature brown trout, but not in immature rainbow trout, despite plasma cortisol levels being similar in both cases. Cortisol implantation in mature brown and rainbow trout significantly increased the mortality rate due to bacterial and fungal infection compared with control fish. Furthermore, the mortality rate due to disease was significantly greater in brown trout than rainbow trout, despite both groups receiving similar doses of steroid. (Author's abstract)
W89-11674

QUANTITATIVE STRUCTURE--ACTIVITY RELATIONSHIPS FOR THE TOXICITY OF SELECTED SHALE OIL COMPONENTS TO MIXED MARINE BACTERIA.
Griffith Univ., Nathan (Australia). School of Australian Environmental Studies.
M. S. J. Warne, D. W. Connell, D. W. Hawker, and G. Schuurmann.
Ecotoxicology and Environmental Safety EESADV, Vol. 17, No. 2, p 133-148, April 1989. 1 fig, 5 tab, 45 ref. Umweltbundesamt, project 10604019/02.

Descriptors: *Structure-activity relationships, *Water pollution effects, *Toxicity, *Oil shale, *Marine bacteria, Bioassay, Regression analysis, Correlation analysis, Benzene, Naphthalene, Phenols, Pyridines, Aliphatic hydrocarbons.

The toxicity of 32 shale oil components to a mixed marine bacterial culture was assessed utilizing an acute static bioassay protocol. The toxicity of the various shale oil components was found to range from log EC50 (mol/L) values of 1.62 for pyridine to -2.50 for n-hexylbenzene. Structure-activity relationships were examined between toxicity and 39 physicochemical properties and molecular descriptors, many of which have not been previously utilized in quantitative structure-activity relationship (QSAR) research. The toxicity could be predicted with reasonable accuracy using simple linear regression equations. However, multiparametric linear regression (MLR) equations yielded improved correlation coefficients and predictive capabilities. Such equations allow the inclusion of two or more characteristics in one relationship. The best MLR equations combined carbon number and interatomic distance between the most positive and negative charges, solubility, the approximate sigma electron density, and a variety of other parameters. These multiparametric QSARs with high predictive capabilities require computer-generated data which may not be readily available. Other MLR equations combine parameters such as the octanol water partition coefficient and the specific molecular connectivity index. These latter equations have lower correlation coefficients and yet are probably of more practical use as the data required are readily available or can be calculated. The presented multiparametric QSARs are applicable within the log of the octanol/water partition coefficient range of 0.6 to 5.5 and with mixed marine bacteria can be used to predict the toxicity of alkyl-substituted benzenes, naphthalenes, phenols, pyridines, and aliphatic compounds with a reasonable level of accuracy. (Author's abstract)
W89-11727

TOXICITY TEST OF LANDFILL LEACHATE USING SAROTHERODON MOSSAMBICUS (FRESHWATER FISH).
Hong Kong Baptist Coll., Kowloon. Dept. of Biology.
M. H. Wong.
Ecotoxicology and Environmental Safety EESADV, Vol. 17, No. 2, p 149-156, April 1989. 2 fig, 5 tab, 25 ref.

Descriptors: Tilapia, Toxicity, *Bioassay, *Landfills, *Hong Kong, *Leachates, Total solids, Ammonia, Metals, Alum, Rainfall-runoff relationships, Fish, Infiltration.

Landfill leachate was collected in March and July, 1984 at the Gin Drinkers' Bay Landfill Site, and the properties of the two leachates were examined. The leachate collected in March contained higher contents of total solids, ammonia, and metals than that collected in July. The leachates were treated with EDTA (.01 M) and Al2(SO4)3 (2 and 4 g/L), alone and in combination. Addition of alum (2 g/L) removed more than 60% of the phosphate content of the two leachates, and about 20 and 68% of total solids from leachates collected in March and July, respectively. Different concentrations of the leachates (untreated and alum-treated) were used to test the survival of tilapia, Sarotherodon mossambicus. The 96-hr LC50 for untreated leachates of March and July were 1.4 and 12% respectively. The alum-treated leachates raised the 96-hr LC50 to 2.2 and 31.4%, accordingly. The composition of the leachate especially of other organic substrates such as phenol, should be analyzed to obtain as clear a picture of the leachate as possible. The ultimate method to reduce the production of leachate is to prevent the infiltration of rainwater into the soil. (Author's abstract)
W89-11728

1,1,1-TRICHLOROETHANE: MEDIUM-TERM TOXICITY TO CARP, DAPHNIDS, AND HIGHER PLANTS.
Imperial Chemical Industries Ltd., Brixham (England). Brixham Lab.
R. S. Thompson, and N. G. Carmichael.
Ecotoxicology and Environmental Safety EESADV, Vol. 17, No. 2, p 172-182, April 1989. 2 fig, 5 tab, 22 ref.

Descriptors: *Chlorinated hydrocarbons, *Waterfleas, *Macrophytes, *Water pollution effects, *Toxicity, *Carp, *Bioassay, Trichloroethane, Daphnia, Vascular plants, Seedlings, Solvents, Sorghum, Vegetable crops, Fate of pollutants.

The toxicity of 1,1,1-trichloroethane to carp (Cyprinus carpio) and daphnids (Daphnia magna) and the effects of gaseous-phase exposure on the growth of higher plants (sorghum bicolor and brassica napus) were investigated. The test systems were designed to minimize loss of the volatile material during the exposure period. During an exposure period of 14 days, there were no mortalities or other symptoms of toxicity in carp exposed to a mean measured 1,1,1-trichloroethane concentration of 7.7 mg/L. The survival and reproduction of daphnids over a test period of 17 days were not affected at a measured concentration of 1.3 mg/L. Growth of emergent seedlings was not inhibited at measured gaseous-phase concentrations of 18 mg/L for S. bicolor and 6.9 mg/L for B. napus. The simple modifications made to standard techniques proved sufficient to maintain the exposure concen-

trations of this volatile chemical. Mean measured concentrations were generally greater than 60% of the nominal values. It was concluded that the concentrations used in this study would only affect fish, daphnids, and higher plants as a result of a gross accidental contamination, and that the physical characteristics of the material dictate that it would be rapidly dispersed. (Author's abstract)
W89-11731

EFFECTS OF METAL IONS ON CYPRINID FISH IMMUNE RESPONSE: IN VITRO EFFECTS OF ZN(2+) AND MN(2+) ON THE MITOGENIC RESPONSE OF CARP PRONEPHROS LYMPHOCYTES.
Limoges Univ. (France). Lab. d'Immunophysiologie Generale et Comparee.
Z. Ghanmi, M. Rouabhia, O. Othmane, and P. A. Deschaux.
Ecotoxicology and Environmental Safety EESADV, Vol. 17, No. 2, p 183-189, April 1989. 2 fig, 4 tab, 19 ref. Environmental Ministry Grant 237 01 87 40021.

Descriptors: *Immunoassay, *Zinc, *Manganese, *Fish physiology, *Water pollution effects, *Carp, Pronephros, Mitogens, Thymidine, Calcium chloride, Inhibition.

Lymphocytes from the pronephros of carp (Cyprinus carpio L) have been subjected to transformation by mitogens, concanavalin A (Con A), phytogemagglutinin (PHA), and lipopolysaccharides (LPS), with Zn or Mn at varying concentrations. Addition of Zn(2+) (10 to the minus 7th power to .010 M) to mitogen-stimulated T and B cells enhanced (3H) thymidine incorporation. Addition of 0.00010 M Zn(2+) inhibited the response to Con A, PHA, and LPS. At this concentration, Zn was toxic. Addition of Mn(2+) (10 to the minus 7 power to .010 M) to mitogen-stimulated lymphocytes enhanced (3H) thymidine incorporation. This effect was observed with Con A-stimulated and PHA-stimulated lymphocytes, but not with LPS-stimulated lymphocytes. In contrast, addition of 1.0 M Mn(2+) to lymphocyte cultures exerted an inhibitor effect on the response to Con A or to PHA, while the response to LPS was unaffected. Addition of 1.0 Mn(2+) to Con A-stimulated or PHA-stimulated cultures at different times after initiation of stimulation indicated that Mn(2+) was inhibitory only when it was added before the first 16 hr of cultures. The inhibition induced by 1.0 M Mn(2+) could be reversed by adding 2 mM CaCl2 to the culture. (Author's abstract)
W89-11732

INHIBITION OF ACETYLCHOLINESTERASE IN GUPPIES (POECILIA RETICULATA) BY CHLORPYRIFOS AT SUBLETHAL CONCENTRATIONS: METHODOLOGICAL ASPECTS.
Institute for Pesticide Research, Wageningen (Netherlands).
For primary bibliographic entry see Field 5A.
W89-11733

HISTOPATHOLOGICAL ALTERATIONS IN THE LIVER OF FRESHWATER TELEOST TILAPIA MOSSAMBICA IN RESPONSE TO CADMIUM TOXICITY.
Sri Venkateswara Univ., Tirupati (India). Pesticide and Industrial Toxicology Centre.
A. U. Rani, and R. Ramamurthi.
Ecotoxicology and Environmental Safety EESADV, Vol. 17, No. 2, p 221-226, April 1989. 6 fig, 18 ref.

Descriptors: *Tissue analysis, *Animal pathology, *Tilapia, *Liver, *Water pollution effects, *Toxicity, *Cadmium, Fish physiology, Bioindicators, Gills, Pathology, Histology, Pancreas, Lethal limit, Sublethal effects, Blood, Microscopic analysis, Heavy metals.

The effects of lethal (50 ppm) and sublethal (5 ppm) concentrations of CdCl2 on the liver of the freshwater teleost Tilapia mossambica were studied by routine histological technique. For lethal exposures the blood vessels were engorged and filled with blood. Severe vacuolar degeneration of the peripancreatic hepatocytes and pancreatic cells was evident in most of the hepatocytes. However, in some, the pancreatic cells were necrosed. After the first day of exposure to sublethal concentrations, no gross lesions were seen. However, vacuolar degeneration in the hepatocytes surrounding the pancreatic cells as well as the subcapsular areas was noted microscopically. At 7 and 15 day of exposure, there was severe congestion and vacuolar degeneration of the hepatocytes surrounding the cells, and, in a few, the pancreatic cells were completely necrosed. Additional changes observed after 15 days of exposure included congestion of the blood vessels, vacuolar degeneration at many places in the hepatocytes and pancreatic cells, and necrosed pancreatic cells and fatty changes in the perpancreatic hepatocytes. The major histopathological alterations observed in the liver tissue exposed to cadmium might be due to hepatic accumulation of the metal. As liver is a metabolically active center for all biochemical processes and a major site for synthesis, storage, and turnover of metabolites, the present study serves as an index for any metabolic disfunction. Therefore, the tissues of fish like liver and gills may serve as sensitive bio-indicators of metal pollution in the aquatic medium, and histopathological studies in turn reveal the extent of pollution as a metal selectively damages a particular organ. (White-Reimer-PTT)
W89-11734

OVARIAN DAMAGE TO CHANNA PUNCTATUS AFTER CHRONIC EXPOSURE TO LOW CONCENTRATIONS OF ELSAN, MERCURY, AND AMMONIA.
Griffith Univ., Nathan (Australia). School of Australian Environmental Studies.
S. Dey, and S. Bhattacharya.
Ecotoxicology and Environmental Safety EESADV, Vol. 17, No. 2, p 247-257, April 1989. 9 fig, 1 tab, 20 ref.

Descriptors: *Animal pathology, *Sublethal effects, *Tissue analysis, *Water pollution effects, *Pesticide toxicity, *Organophosphorus pesticides, *Fish physiology, *Mercury, *Ammonia, Elsan, Reproduction, Murrels, Ovaries, Chronic effects, Spawning.

In order to investigate the effects of a nonlethal concentration of an organophosphorus insecticide, Elsan (Phenthoate, 211 ppb), a heavy metal salt (HgCl2, 16.7 ppb), and a nitrogenous ammonia product (NH4OH, 15.64 ppm) on ovarian weights, the occurrence of oocytes of various categories, and the diameters of different stages of oocytes in the ovaries of fresh water murrel (Channa punctatus) were evaluated during chronic exposure for 90 days. In the breeding season, treated C. punctatus revealed a significant decrease in ovarian weight throughout the duration of the experiment. Acute changes were noted in the diameter and percentage occurrence of the different stages of oocytes. In all cases, stage I oocytes revealed no difference in diameter with respect to controls although they demonstrated an increase in the percentage occurrence. For stages II and III, a remarkable decrease occurred in both the number and the diameter of these mature oocytes. The preponderance of stage I and destruction of stage II and stage III oocytes in all three treatments indicate that chemically diverse xenobiotics have equal reproductive toxicity in fish, interfering with their breeding. (Author's abstract)
W89-11735

SOME THEORETICAL AND FIELD ASPECTS OF REINJECTION IN GEOTHERMAL RESERVOIRS.
California Univ., Berkeley. Earth Sciences Div.
For primary bibliographic entry see Field 5E.
W89-11765

ACIDIFICATION OF NATIVE BROOK TROUT STREAMS IN VIRGINIA.
Virginia Univ., Charlottesville. Dept. of Environmental Sciences.
For primary bibliographic entry see Field 5B.
W89-11776

EFFECT OF THE SOLVENT ACETONE ON MEMBRANE INTEGRITY IN THE GREEN ALGA CHLORELLA PYRENOIDOSA.
Nova Scotia Agricultural Coll., Truro. Environmental Microbiology Lab.
G. W. Stratton.
Bulletin of Environmental Contamination and Toxicology BECTA6, Vol. 42, No. 5, p 754-760, March 1989. 2 fig, 18 ref.

Descriptors: *Solvents, *Chlorophyta, *Chlorella, *Toxicity, *Algae, *Water pollution effects, Membrane integrity, Algal growth, Photosynthesis, Radiochemical analysis, Bioassay, Pesticides, Cell leakage.

A method was developed for monitoring the effects of acetone on membrane integrity and cell leakage in the green alga Chlorella pyrenoidosa. The data presented here indicate that the leakage of the radio-labelled compounds from cells C. pyrenoidosa into the growth medium can be used a sensitive measure if solvent toxicity. Results from leakage studies are consistent and comparative with those obtained from other solvent toxicity experiments using toxicity criteria such as growth and photosynthesis. The method outlined here can be applied to any solvent bioassay system employing algae and, with appropriate modifications, can be used to follow the leakage of any radio-labelled compound from the cells. With C. pyrenoidosa, acetone-induced damage to membrane integrity appears to be a primary toxic effect of acetone. This could lead to alterations in the uptake of pesticides present in the same test system, thereby eliciting pronounced interaction responses. (Miller-PTT)
W89-11812

TOXICITY TO AND OXYGEN CONSUMPTION OF THE FRESHWATER SNAIL THIARA (STENOMELANIA) TORULOSA (BRUGUIERE) IN RELATION TO ORGANOPHOPHORUS INSECTICIDE EXPOSURE.
Andhra Univ., Waltair (India). Dept. of Zoology.
C. Bharathi, and D. G. V. Prasada-Rao.
Bulletin of Environmental Contamination and Toxicology BECTA6, Vol. 42, No. 5, p 773-777, March 1989. 1 fig, 1 tab, 8 ref.

Descriptors: *Pesticides, *Water pollution effects, *Insecticides, *Snails, *Organophosphorus pesticides, *Toxicity, Mortality studies, Oxygen requirements, Sublethal effects, Enzymes, Animal physiology, Respiration.

The toxicity and the effect on the oxygen uptake is described in relation to organophosphate insecticides (phophamidon, monocrotophos, dichlorvos) on a fresh water snail Thiara torulosa. The results obtained on dose mortality studies of the three organophosphate compounds on Thiara torulosa reveal that the animals react differently to the different insecticides. Oxygen consumption values with respect to the three insecticides showed a significant increase at sub-lethal concentrations. The percentage mortality of Thiara torulosa increased with increase in concentration of all three insecticides tested. Concentrations for a 24-hour period of exposure of the snails are significant. However, prolonged exposure to sub-lethal concentrations might cause disorders due to cumulative effects. From the results, it is possible to infer that the changes in the physiological activity of the snails caused by the exposure to various toxicants might be due to the interference of the toxicants with the respiratory enzyme chain. It is also possible that surface cells are damaged. Internal persistent poisoning possibly influences the respiratory response although the mode of action is not understood. (Miller-PTT)
W89-11814

TOXICITY OF ALUM SLUDGE TO CERIODAPHNIA DUBIA AND PIMEPHALES.
Johns Hopkins Univ., Shady Side, MD. Aquatic Ecology Section.
W. S. Hall, and L. W. Hall.
Bulletin of Environmental Contamination and Toxicology BECTA6, Vol. 42, No. 5, p 791-798, March 1989. 2 tab, 6 ref.

Descriptors: *Waterfleas, *Fathead minnows, *Water treatment wastes, *Waste disposal, *Water pollution effects, *Sludge, *Alum sludge, *Toxicity, Water treatment plants, Wastewater pollution effects, Hydrogen ion concentration, Dissolved oxygen, Suspended solids, Aluminum.

Acute and chronic toxicity of a large drinking water treatment plant's 'alum sludge' effluent to a freshwater fish and invertebrate is evaluated. The objectives were to: (1) evaluate alum sludge toxicity to Ceriodaphnia dubia and to Pimephales promelas larvae and juveniles, (2) monitor water quality parameters which may influence effluent toxicity, and (3) compare results of tests with each species. Reductions in pH and dissolved oxygen concentrations, high levels of suspended solids, and possibly aqueous aluminum were implicated as likely causes of toxicity in C. dubia tests while high suspended solids likely caused toxicity in the P. promelas 'worst case' experiment. Total aluminum concentrations in seven-day tests were usually > 100 mg/l, while aqueous aluminum concentrations in all tests were < 0.5 mg/l. The vast majority of aluminum in the effluent was undissolved and apparently not available to exert substantial toxicity. The P. promelas 'worst case' experiments indicated that unfiltered effluent was acutely toxic at high concentrations, and agreed well with results of C. dubia experiments. The utility of C. dubia seven day test is clear from the results of this research. The sub-lethal effects at high effluent concentrations were quite evident. Sub-lethal effects to fathead minnows were not observed. Although dissolved aluminum may have played a role in exerting sub-lethal toxicity, results of water quality concentrations and high levels of suspended solids were likely responsible for the observed effects. Some non-conventional toxins were implicated as exerting toxicity. The full toxicity of this unique effluent would not have been detected using conventional acute toxicity tests. The constantly-observed changes in water chemistry parameters indicated effluent equilibration was occurring. Highest levels of aqueous aluminum were observed at 6.3% effluent. Therefore, alum sludge effluents may serve as a source of toxic aluminum due to equilibrium processes, especially under lower pH conditions. (Miller-PTT)
W89-11816

WATER-QUALITY ASSESSMENT USING AQUATIC MACROINVERTEBRATES FROM STREAMS OF THE LONG PINE CREEK WATERSHED IN BROWN COUNTY, NEBRASKA,
Nebraska State Dept. of Environmental Control, Lincoln. Water Quality Div.
For primary bibliographic entry see Field 6G.
W89-11821

PLATYMONAS BLOOM IN COASTAL WATERS OF JEDDAH, SAUDI ARABIA,
King Abdulaziz Univ., Jeddah (Saudi Arabia). Faculty of Marine Science.
S. M. Saifullah, A. S. Mandura, and A. K. Khafaji.
Pakistan Journal of Botany PJBOB6, Vol. 20, No. 2, p 285-289, December 1988. 3 fig, 17 ref.

Descriptors: *Water pollution effects, *Coastal waters, *Eutrophication, *Wastewater outfall, *Red Sea, *Saudi Arabia, Waste disposal, Phytoplankton, Wastewater pollution.

A dense green bloom of Platymonas intermedia Nasr observed in coastal waters of Jeddah city (Saudi Arabia) was in close vicinity to the point of discharge of the city's sewage. Cell counts were as high as 38 million cells/L. While carrying out a field trip to south corniche of Jeddah city on November 22, 1986, it was noticed that the coastal waters extending to several hundred meters in length and width were dark green in color instead of the normal blue. The green patches or clouds were swarming in very shallow waters close to the upper water mark. Some 30 to 40 meters further away from the shore, the intensity of the bloom increased and the water appeared like a dense green soup. Temperature and salinity values recorded were 29 C and 25 ppt, respectively. Microscopic observations revealed the organisms causing the bloom to be swarms of a green unicellular phytoplankter Platymonas intermedia Nasr. Although many studies have been carried out on marine algae of Saudi Arabia Red Sea waters, none of them ever reported Platymonas from the sea. The bloom was overwhelmingly monospecific showing a count of as many as 37,955,600 cells of P. intermedia per litre. The other species present were extremely rare and negligible. Green flagellates have been reported to form dense blooms elsewhere as well. The cause is not known. However, there is strong evidence that sewage pollution may be the cause of the bloom since most of the domestic sewage of Jeddah city is discharged very close to the point of occurrence of the bloom. (Miller-PTT)
W89-11823

METABOLISM OF POLYCYCLIC AROMATIC HYDROCARBONS IN THE AQUATIC ENVIRONMENT.
For primary bibliographic entry see Field 5B.
W89-11826

FACTORS INFLUENCING EXPERIMENTAL CARCINOGENESIS IN LABORATORY FISH MODELS.
Oregon State Univ., Corvallis. Dept. of Food Science and Technology.
G. S. Bailey, D. E. Goeger, and J. D. Hendricks.
IN: Metabolism of Polycyclic Aromatic Hydrocarbons in the Aquatic Environment. CRC Press, Inc., Boca Raton, Florida. 1989. p 253-268, 7 tab, 62 ref. Public Health Service Grants ES00092, ES00541, ES00210, ES03850, CA34732 and CA398398.

Descriptors: *Hydrocarbons, *Water pollution effects, *Carcinogens, *Fish, *Model studies, Biological studies, Fish physiology, Public health, Growth rates, Nutrients, Fish diseases, Epidemiology, Aquatic environment, Population exposure.

The likely impact of an environmental carcinogen on any fish population will depend on the amount of exposure received by each susceptible life-stage, the ability of each stage to absorb and metabolize the carcinogen and to repair any ensuing damage, and the genetic consequences for tumor induction per unit of genomic damage in target organs at each developmental age. The studies reviewed in this chapter demonstrate that in laboratory fish models, several additional factors may have significant impact on the population response to a given chemical carcinogen. These include, but may not be limited to, developmental age at exposure, route of exposure, genetic variation, nutritional status and growth rate, nutrient and non-nutrient modulators of carcinogenicity, and water temperature during initiation and/or growth. When considered individually, the effect of each parameter on experimental carcinogenicity seems not to be great, generally less than one order of magnitude. However, it may be a rare circumstance that only one such variable will be operative in comparison of tumor incidences among feral fish populations. More frequently, some combination of several such variables may operate, along with carcinogen exposure, to determine the tumor incidence in populations under comparison. The major impediment to identification of specific etiological agents in feral fish neoplasia may well be the difficulties imposed by the existence of highly complicated mixtures of genotoxic compounds. This will be superimposed on an intermittent and variable exposure of host species to compounds which can modulate fish response to environmental carcinogens. By analogy to human epidemiological studies, careful recognition and control for each known confounding variable will be essential for causative tumorigenic agents in the aquatic environment to be identified confidently. (See also W89-11826) (Lantz-PTT)
W89-11834

PAH, METABOLITES, AND NEOPLASIA IN FERAL FISH POPULATIONS.
National Fisheries Contaminant Research Center, Columbus, OH. Field Research Station.
P. C. Baumann.
IN: Metabolism of Polycyclic Aromatic Hydrocarbons in the Aquatic Environment. CRC Press, Inc., Boca Raton, Florida. 1989. p 269-289, 7 fig, 4 tab, 74 ref.

Descriptors: *Hydrocarbons, *Water pollution effects, *Polycyclic aromatic hydrocarbons, *Cancer, *Fish physiology, Puget Sound, Lake Erie, Niagara River, Black River, Case studies, Liver, Bullhead, Mice, White sucker, Sole, Benz(a)pyrene, Metabolites.

The three case histories highlighted here (field and laboratory studies of polycyclic aromatic hydrocarbons (PAH) and neoplasia at: Puget Sound, Washington; Eastern Lake Erie and Niagara River; and Black River near Lake Erie), have a number of similarities. Frequency of liver neoplasia, was high in bottom-dwelling fish at each location. Bottom sediments in the areas that these fish populations inhabited contained elevated levels of PAH, including known mammalian carcinogens such as benzo(a)pyrene (BaP). The PAH concentrations were typically several orders of magnitude greater than those recorded from less polluted areas. Skin painting experiments with PAH extracted from sediments produced papillomas in brown bullheads (Buffalo River sediment) and in Swiss mice (Buffalo River sediments). Furthermore, elevated levels of PAH were found in the stomach contents of English sole and white suckers from populations with high frequencies of neoplasia. Elevated PAH levels have been demonstrated in fish tissue from all three research areas. Experiments with English sole and brown bullhead have demonstrated the ability of both species to metabolize BaP to carcinogenic derivatives, and have documented the subsequent formation of DNA adducts. Bile of feral fish from all locations has been found to contain PAH metabolites. A recent significant experiment demonstrated that hepatic carcinoma can be induced in rainbow trout, by exposure to dietary BaP. Although this research taken as a whole does not demonstrate cause and effect, these field studies and the results of laboratory investigations can best be interpreted by assuming the pathology to be the result of a carcinogen taken by fish from their environment by way of the diet, or by water and sediment intake or contact, and activated by hepatic enzymes. (See also W89-11826) (Lantz-PTT)
W89-11835

HYDROCARBONS IN MARINE MOLLUSKS: BIOLOGICAL EFFECTS AND ECOLOGICAL CONSEQUENCES.
Marine Biological Association of the United Kingdom, Plymouth (England).
M. N. Moore, D. R. Livingstone, and J. Widdows.
IN: Metabolism of Polycyclic Aromatic Hydrocarbons in the Aquatic Environment. CRC Press, Inc., Boca Raton, Florida. 1989. p 291-328, 11 fig, 7 tab, 201 ref.

Descriptors: *Bioaccumulation, *Hydrocarbons, *Hydrocarbons, *Marine environment, *Mollusks, *Ecological effects, *Water pollution effects, *Fate of pollutants, Biological studies, Toxicity, Environmental effects, Polycyclic aromatic hydrocarbons, Biotransformation, Sublethal effects, *Biological magnification, Physiological ecology, Animal physiology.

Polycyclic aromatic hydrocarbons (PAH) represent a major class of environmental contaminant originating from both petrogenic and pyrogenic sources. Marine organisms, including mollusks, accumulate PAH in their body tissues and concentrate them to a marked degree over seawater levels. Much of the current understanding of the toxic effects of hydrocarbons (including PAH) and other contaminants in marine mollusks is as yet very simplistic in comparison to mammalian studies. The value of using an integrated approach to the problem of assessment of sublethal effects of PAH in mollusks is evident, particularly in facilitating the development of conceptual linking of responses at several levels of biological organization. In the case of cytochrome P-450 in mollusks, understanding of the role of this system in the 'normal' physiology, such as the hydroxylation of endogenous substrates, is even less than its presumed role in processes of xenobiotic biotransfor-

mation. There is clearly considerable scope for future research into the functions of cytochrome P-450 and the regulation of these processes, from a fundamental biochemical standpoint as well as evolutionary one. Although lysosomal function in mollusks is more clearly understood, there are still considerable gaps in the knowledge. Regulation of lysosomal catabolism is critical in maintaining cellular homeostasis and this is evidently perturbed by exposure to PAH. The nature of these control mechanisms, which often involve membrane-membrane interactions, is complex and unclear. Lysosomally related processes involve endocytosis, phagosome-lysosome interaction, autophagy, and exocytosis. A major difficulty in the use of marine mollusks in environmental impact assessment involves the limited understanding of the mechanisms of toxicity of PAH in these animals; consequently, this raises problems in the interpretation of the significance or specificity of any biological responses measured, whether at the molecular, cellular, or whole-animal levels of organization. (See also W89-11826) (Lantz-PTT)
W89-11836

ACID TOXICITY AND AQUATIC ANIMALS.
Cambridge University Press, Cambridge. 1989. 282 p. Edited by R. Morris, E. W. Taylor, D. J. A. Brown, and J. A. Brown.

Descriptors: *Acid rain effects, *Hydrocarbons, *Acidic water, *Aquatic animals, *Water pollution effects, *Acid rain, Field tests, Toxicity, Mortality, Invertebrates, Ecological effects, Environmental effects, Trace metals, Biological studies, Fish, Synergistic effects, Survival, Animal physiology, Respiration, Physiological ecology.

This book presents a review of recent research on acid waters and their effects on aquatic animals. Starting initially with the environment in order to assess why the problems have arisen in particular areas, the book then deals with field and survival studies on invertebrates and vertebrates and examines the extent of the biological problem and the attempts which have been made to relate water quality and the susceptibility of animals. Major advances in this area have included the realization that declining populations are often the result of acid waters and their interactions with traces of other ions and that these situations produce the most several physiological problems. The natural progression of environmental and field studies, toxicity and survival tests provide the background information for the physiological studies which follow. These form the major component of the book and they seek to analyze the toxic effects of acid waters and trace metals on acid-base balance, respiration, ionic balance together with cardiovascular and endocrinological effects. While it is inevitable that most contributions concentrate on fish as the dominant species of economic importance, invertebrate studies are also included. (See W89-11838 thru W89-11851) (Lantz-PTT)
W89-11837

CAUSES AND CONSEQUENCES OF SURFACE WATER ACIDIFICATION.
Imperial Coll. of Science and Technology, London (England). Centre for Environmental Technology.
For primary bibliographic entry see Field 5B.
W89-11838

INVERTEBRATE COMMUNITIES IN ACID STREAMS.
Freshwater Biological Association, Ambleside (England).
D. W. Sutcliffe, and A. G. Hildrew.
IN: Acid Toxicity and Aquatic Animals. Cambridge University Press, Cambridge. 1989. p 13-29, 8 fig, 1 tab, 51 ref.

Descriptors: *Acid streams, *Ecosystems, *Hydrocarbons, *Invertebrates, *Ecological effects, Hydrogen ion concentration, Insects, Crustaceans, Mollusks, Toxicity, Chemical analysis, Benthic fauna, Platyhelminthes, Oligochaetes, Species composition, Food chains, Predation.

Stony streams normally contain a characteristic fauna of benthic macroinvertebrates, prominent among which are insects, especially Ephemeroptera, Plecoptera, Trichoptera and Diptera. Also present are flatworms, oligochaetes,a few malocostracan crustaceans and mollusks. In streams with moderate alkalinity and a pH of > or = 6, the fauna is rich in total numbers of species (usually there are some 70-90 taxa) and many of these may be abundant. In acid streams where the mean pH is below 5.7-5.4, however, there is a distinct change in faunal composition. Some taxa disappear or become scarce, particularly mayflies, some caddisflies, crustaceans and mollusks. The fauna is therefore impoverished in species and may contain only half the number of taxa found in less acid (soft water) streams. Three main hypotheses can account for these observations; they are not necessarily exclusive and factors within all three probably interact to determine the composition of invertebrate communities. First, the chemical conditions in acidified waters are intolerable to some taxa or have sublethal physiological effects; some animals may actively avoid such waters. Second, the chemical conditions affect invertebrates indirectly via their food supply. Third, the absence of fish from many acidified waters removes predation pressure and produces ramifying community effects. In this chapter, the particular chemical characteristics of soft waters are described, and then each of these three hypotheses are discussed in turn. (See also W89-11837) (Lantz-PTT)
W89-11839

FISH SURVIVAL IN ACID WATERS.
Central Electricity Generating Board, Leatherhead (England). Central Electricity Research Labs.
D. J. A. Brown, and K. Sadler.
IN: Acid Toxicity and Aquatic Animals. Cambridge University Press, Cambridge. 1989. p 31-44, 2 fig, 1 tab, 48 ref.

Descriptors: *Survival, *Acid rain effects, *Hydrocarbons, *Water pollution effects, *Fish, *Mortality, *Acidic water, Aluminum, Acid rain, Calcium, Hardness, Trout, Lake fisheries, Toxicity, Hydrogen ion concentration, Fluorides, Norway.

This paper reviews the field and laboratory data on the chemical factors which affect fish and fishery survival in acid waters, and attempts to relate the two sets of data where this is possible. In general, the field data being considered are predominantly from Norway where the fish species is mainly brown trout, but, where relevant, data from North America will be described. The main chemical factors, other than pH that are discussed are calcium (hardness) and aluminum concentration. Calcium is found to be very important for freshly fertilized fish egg survival at low pH, and there is an undeniable relationship between pH and calcium concentration and the ability of a lake to support a fishery. As far as aluminum is concerned, superficially, at least, there is also a connection between the previous bioassay results, with improved fish survival and lakes more likely to have a fishery, if the calcium concentration is 50 microequivalents/L (uequiv/L) or more, even though these lakes are the ones with higher aluminum concentrations. Several researchers have investigated variations caused by different toxicities of aluminum and calcium, along with pH, for various time periods ranging from daily for three weeks to monthly for a year. The common findings are: (1) that total aluminum levels increase during low pH conditions and that most of this increase is accounted for by the labile inorganic fraction; and (2) that the dominant component of this monomeric fraction is the fluoride complexes which constitute between 40 and 50% in the Norwegian examples, 50-60% in the American (Adirondack) data, and 70-90% in the Canadian examples. (See also W89-11837) (Lantz-PTT)
W89-11840

FIELD STUDIES ON FISHERIES IN ACID WATERS IN THE UNITED KINGDOM.
Central Electricity Generating Board, Fawley (England). Marine Biological Unit.
A. W. H. Turnpenny.
IN: Acid Toxicity and Aquatic Animals. Cambridge University Press, Cambridge. 1989. p 45-65, 8 fig, 8 tab, 42 ref.

Descriptors: *Acid rain effects, *Hydrocarbons, *Fisheries, *Water pollution effects, *Acidic water, Field tests, Hydrogen ion concentration, Fishkill, Species diversity, Animal pathology, Reforestation, Wales, Scotland, England, Toxicity, Chemical analysis, Trace metals.

Fish have long been known to occur in acid waters in the UK. The fact that a number of recent studies reviewed here have shown impoverished fish fauna in acid streams in the UK does not in itself imply that a problem has suddenly arisen, but rather reflects the current global interest in surface water acidification. With the recent introduction of continuous recording pH meters on a number of acid-susceptible rivers of the UK, and the use of pathological techniques (e.g. analysis of blood chemistry) for the identification of acid stress, it is possible that such incidents will be more frequently recognized and reported in the future. There is strong evidence of links between fishery decline and afforestation in parts of Wales and Scotland. Increased acidity of drainage waters together with elevation of toxic trace metal levels appear to be the limiting factor on fisheries since acutely lethal toxic conditions have been shown to result. The upland stream data reviewed here demonstrate that the fish fauna of these waters becomes progressively impoverished through successively lower pH classes. At values in the range pH 5-6.5, not normally considered harmful to fish, fishery status was significantly lower than in circumneutral (pH 6.5-7.5) streams. This discrepancy must arise from the fact that fish production in natural waters is dependent upon a whole complex of physical, chemical and biological factors, not mean pH alone. Of these, chemical factors appear to be the most important, especially elevated levels of toxic trace metals which often accompany low pH. The importance of trace metals in acid waters has been shown to vary regionally, depending on background geochemistry. There is also evidence that the limiting conditions in upland streams may not relate to mean water chemistry values, but rather to episodic extremes. (See also W89-11837) (Lantz-PTT)
W89-11841

EPISODIC CHANGES IN WATER QUALITY AND THEIR EFFECTS ON FISH.
Nottingham Univ. (England). Dept. of Zoology.
J. P. Reader, and C. H. Dempsey.
IN: Acid Toxicity and Aquatic Animals. Cambridge University Press, Cambridge. 1989. p 67-83, 2 fig, 2 tab, 50 ref.

Descriptors: *Fishkill, *Acid rain effects, *Hydrocarbons, *Water pollution effects, *Water quality, *Weathering, *Chemical analysis, Hydrogen ion concentration, Calcium, Aluminum, Zinc, Manganese, Lead, Iron, Rainfall, Snowmelt, Toxicity.

Episodes of high discharge in watercourses in areas with low conductivity water and weathering-resistant bedrock are accompanied by a fall in pH and a rise in concentrations of trace metals. Other changes occurring at the same time may include a dilution of the major inorganic ions (e.g. Ca(2+)). Of the trace metals, aluminum has been most studied. Other trace metals have received little attention, but several (Fe, Pb, Mn, Zn) have been found to increase in concentration during episodes, and it is possible that others may behave in the same way. The wide variety of conditions which determine the nature of an episode, and a paucity of studies providing comprehensive and continuous water analysis, preclude the description of a 'typical' episode. However, episodes associated with snowmelt are usually much longer than those caused by heavy rain, and have a more marked dilution of major ions. In short, rain-associated, episodes this dilution effect may be absent, and increases in concentration of major ions may occur. Fishkills are sometimes observed during high discharge low pH episodes. However, detailed study of these fishkills and their causes is difficult, because of their sporadic and unpredictable occurrence. It is likely that they play an important part in fish population decline in acid waters. The deaths

appear to be the consequence of trace metal toxicity (particularly aluminum), accompanying the concentration increases and speciation changes associated with a fall in Ph, and failure of ionoregulation is a likely cause of death. However, unequivocal evidence is lacking, both for the mechanisms of fishkills and for their role in population decline. (See also W89-11837) (Lantz-PTT)
W89-11842

ACID-BASE REGULATION IN FISHES. 1. MECHANISMS.
Max-Planck-Inst. fuer Experimentelle Medizin, Goettingen (Germany, F.R.). Abt. Physioilogie.
N. Heisler.
IN: Acid Toxicity and Aquatic Animals. Cambridge University Press, Cambridge. 1989. p 85-97, 7 fig, 28 ref.

Descriptors: *Hydrocarbons, *Acid rain effects, *Fish physiology, *Water pollution effects, Carbon dioxide, Hydrogen ion concentration, Sodium, Ammonia, Chlorine, Acid rain, Acidic water, Buffer capacity.

Three general mechanisms are available for fish acid-base regulation. Buffering is a very effective process for transient removal of surplus H(+) from the body fluids and during transport from the site of production to the site of elimination, but is very much limited by the available buffer capacity (beta-V) of the organism. Buffering of surplus H(+) is always accompanied by changes in the fluid pH, if P sub CO2 cannot be adjusted to compensate pH changes. Adjustment of P sub CO2 by changes in ventilation in water breathing fish, however, is extremely limited by the physical properties of the gas exchange medium (i.e. water), and correlated factors. Final and also transient adjustment of the acid-base status is performed by comparatively potent branchial ion transfer processes. The contribution of net HCO3(-)/Cl(-) ion exchange appears to be predominant, whereas H(+)/Na(+) and NH4(+)/Na(+) are of lesser significance and entail an osmotic problem. The limitations of branchial ion transfer mechanisms mainly reside in the availability of external counter ions, which may be low in naturally soft waters prone to acid pollution. (See also W89-11837) (Lantz-PTT)
W89-11843

ACID-BASE REGULATION IN FISHES. 2. BIOLOGICAL RESPONSES AND LIMITATIONS.
Texas Univ. at Austin, Port Aransas. Port Aransas Marine Lab.
J. N. Cameron.
IN: Acid Toxicity and Aquatic Animals. Cambridge University Press, Cambridge. 1989. p 99-112, 7 fig, 53 ref.

Descriptors: *Acid rain effects, *Hydrocarbons, *Water pollution effects, *Fish physiology, Hydrogen ion concentration, Toxicity, Carbon dioxide, Oxygen, Anemia.

The acid-base status of internal fluids of fish is affected by many different factors, both internal and external. These include temperature, oxygen concentration, carbon dioxide concentration, metabolic substrate, exercise, feeding, anemia, and external pH. Fish have a variety of compensatory mechanisms which act to maintain the acid-base status in a steady state, the set-point of which is a complex function of environmental and internal factors. In most cases, the acid-base regulating system itself is not the primary factor in the ability of fish to survive adverse conditions, but extreme imbalances can lead to death, especially after exercise or hypoxia. (See also W89-11837) (Lantz-PTT)
W89-11844

INTRACELLULAR PH REGULATION AND THE EFFECTS OF EXTERNAL ACIDIFICATION.
Bristol Univ. (England). Dept. of Physiology.
R. C. Thomas.
IN: Acid Toxicity and Aquatic Animals. Cambridge University Press, Cambridge. 1989. p 113-123, 12 fig, 10 ref.

Descriptors: *Hydrocarbons, *Acid rain effects, *Water pollution effects, *Hydrogen ion concentration, *Physiological ecology, *Acidic water, Acid rain, Acidification, Snails, Crayfish, Leeches.

Most measurements of the effects of acid toxicity on aquatic animals concentrate upon changes in body fluid pH and the flux of ions between water and blood. However, relatively little is known about intracellular pH (pH sub i) in most animals, experiments being so far generally confined to those with large neurones. This is because until recently the only way of following pH sub i over long periods was with pH-sensitive microelectrodes. This chapter describes some of the evidence on which the present understanding of pH sub i regulatory mechanisms in snail, crayfish and leech neurones is based, and considers the effects of external acidification before concluding that maintenance of a constant pH sub i depends very much on a constant external pH. (See also W89-11837) (Lantz-PTT)
W89-11845

PHYSIOLOGICAL PROBLEMS OF FISH IN ACID WATERS,
McMaster Univ., Hamilton (Ontario). Dept. of Biology.
C. M. Wood.
IN: Acid Toxicity and Aquatic Animals. Cambridge University Press, Cambridge. 1989. p 125-152, 11 fig, 4 tab, 86 ref. EPRI Contract RP-2346-01.

Descriptors: *Acid rain effects, *Hydrocarbons, *Water pollution effects, *Fish physiology, *Acidic water, Acid rain, Fish, Stress, Acidity, Biological studies, Aluminum, Ecological effects.

Current knowledge on the acute toxic mechanisms of pure acid stress to adult fish is summarized in this review paper. In so doing, the authors attempt to correct the widely held misconception that external water acidity must cause internal acidosis in the animal. The fact that external acidity has proven to be an exceptionally useful probe of normal physiological processes in freshwater teleosts is illustrated. Recent findings on the physiological responses to long-term, low level acid stress, and acid-aluminum interactions, both of which may have greater ecological relevance than short-term acid stress for ultimate survival in the wild, are discussed. In the wild, fish chronically exposed to low levels of Al in mildly acidic soft water may have increased tolerance to short-term increases in Al associated with acid surges. Morphological changes in the gills associated with chronic exposure to sublethal acid/Al levels have recently been described. (See also W89-11837) (Lantz-PTT)
W89-11846

LABORATORY STUDIES ON INVERTEBRATE SURVIVAL AND PHYSIOLOGY IN ACID WATERS.
Centre d'Etude de l'Energie Nucleaire, Mol (Belgium). Lab. for Mineral Metabolism.
J. H. D. Vangenechten, H. Witters, and O. L. J. Vanderborght.
IN: Acid Toxicity and Aquatic Animals. Cambridge University Press, Cambridge. 1989. p 153-169, 5 fig, 1 tab, 31 ref.

Descriptors: *Animal physiology, *Acid rain effects, *Hydrocarbons, *Water pollution effects, *Invertebrates, *Acidic water, Phytoplankton, Zooplankton, Acid rain, Hydrogen ion concentration, Heavy metals, Aluminum, Sodium, Species diversity, Ecological distribution.

Although most attention has been focused on the impoverishment of fish populations in acidified lakes, numerous ecological studies have shown that phytoplankton, zooplankton and benthic invertebrates have decreased in diversity in recently acidified waters. The pH regime, together with the concentrations of various (heavy) metals in the surface waters, has been found to have a profound effect on the distribution of many invertebrates. Many field surveys have clearly pointed out that not only fish are pH sensitive, but invertebrates also suffer from the increased acidity. Laboratory data on the survival of invertebrates exist and some of these data are explained by concomitant observations of changes in physiological parameters, especially Na(+) regulation. Experiments in which the ion regulatory ability is tested in different invertebrate species under conditions of acid pH and elevated Al concentrations reveal that the influence of the ambient water quality is largely correlated with the known environmental distribution of the animals. Species which are found in acid waters display less disturbance in their Na(+) regulation than closely related species which do not live in acid waters. Even within the same species (the waterbug, Corixia punctata), a strongly different reaction on Na(+) influence was noticed at pH 4 when animals from an acid bog were compared with animals from a circumneutral pond. Species living in acid waters seem to display some adaptation of their Na(+) influx mechanism toward high concentrations of H(+). During conditions of acid pH a significant activation of the Na(+) carriers in the integument of insects (corixids) was observed which gives rise to a relatively high net Na(+) uptake even when competition with H(+) is severe. (See also W89-11837) (Lantz-PTT)
W89-11847

PHYSIOLOGICAL PROBLEMS OF CRAYFISH IN ACID WATERS,
Calgary Univ. (Alberta). Dept. of Biology.
B. R. McMahon, and S. A. Stuart.
IN: Acid Toxicity and Aquatic Animals. Cambridge University Press, Cambridge. 1989. p 171-199, 16 fig, 2 tab, 29 ref.

Descriptors: *Animal physiology, *Acid rain effects, *Hydrocarbons, *Water pollution effects, *Crayfish, *Acidic water, Blood, Drought, Tolerance, Growth stages, Crustaceans, Invertebrates, Marshes, Stress.

Although long-term experiments have been carried out only on Procambarus clarki it seems apparent that at least intermolt adults have a remarkable ability to withstand acid exposure. In their ability to correct hemolymph acid-base status and apparently to correct the loss of ions from hemolymph, it appears that this species can recover while maintained in severe acid exposure. The reason for the apparently greater acid tolerance of P. clarki is not known. However, this animal is found naturally in somewhat acid water either in marshy areas or when water stagnates in the burrows to which they are commonly forced by drought. Another Procambarus species, P. fallax, also occurs naturally in acid waters and may also show considerable tolerance. Other species of crayfish are more sensitive and other stages of P. clarki are also likely to show increased acid sensitivity. Present experiments show that some crayfish species can withstand considerably greater acid stress than many fish species and that P. clarki may be able to survive in waters more acid than other crayfish species. Further work on this and other acid-tolerant species is needed to show the manner and extent of acid tolerance. (See also W89-11837) (Lantz-PTT)
W89-11848

COMBINED EFFECTS OF PH AND TRACE METALS ON FISH IONOREGULATION,
McMaster Univ., Hamilton (Ontario). Dept. of Biology.
D. G. McDonald, J. P. Reader, and T. R. K. Dalziel.
IN: Acid Toxicity and Aquatic Animals. Cambridge University Press, Cambridge. 1989. p 221-242, 10 fig, 2 tab, 55 ref.

Descriptors: *Hydrocarbons, *Acid rain effects, *Water pollution effects, *Hydrogen ion concentration, *Trace metals, *Fish physiology, Ions, Calcium, Copper, Gills, Chlorides, Aluminum, Cadmium, Zinc, Manganese.

In freshwater fish, the physiological regulation of the major electrolytes is very sensitive to environmental stressors. Low pH environments in both the laboratory and field, cause electrolyte losses in a number of fish species. Plasma electrolytes have proven to be a fairly reliable indicator of sublethal acid stress. Many of the trace metal contaminants of acid soft waters can be expected to have at least some impact upon branchial ion regulation. The mechanisms of action are likely to be different for each metal, with some being primarily disruptive to Na(+) (and Cl-) balance (Cu, Al, and H(+)), other mainly interfering with Ca(2+) balance (Cd, Zn, Mn), while still others may have little long-term impact on gill function and exert their toxic action almost entirely by internal means (e.g. via neural, hepatic or renal disturbances). For metals that are surface-active, the precise effect on the gills depends upon the metal's concentration in the water, upon its ligand preferences and binding characteristics (i.e., the chemistry of the metal) and upon the water chemistry, in particular water pH, hardness and complexing capacity. Results from this study also confirm that water calcium concentration is an extremely important variable in metal toxicity. The only metal unaffected by calcium levels typical of acid soft waters is copper, and even here Ca(2+) provides some protection against Cu's short-term action on Ca balance. (See also W89-11837) (Lantz-PTT)
W89-11850

ENDOCRINE RESPONSES TO ACID STRESS IN FISH.
Katholieke Univ. Nijmegen (Netherlands).
S. E. Wendelaar Bonga, and P. H. M. Balm.
IN: Acid Toxicity and Aquatic Animals. Cambridge University Press, Cambridge. 1989. p 243-263, 9 fig, 1 tab, 46 ref.

Descriptors: *Acid rain effects, *Hydrocarbons, *Water pollution effects, *Fish physiology, *Stress, *Acidic water, Spawning, Survival, Hormones, Adaptation, Liver, Acid rain.

This survey of the endocrine responses of fish to acid water illustrates that current knowledge is incomplete and limited to a few species. The function of the inter-renal cells and of the pituitary gland has been studied rather extensively, but mainly with respect to osmotic and ionic regulation. Hormones involved in reproduction have not received much attention, although it is well known that the reduction of fish populations in acid water is partly caused by impaired ovarian maturation and reduced ability of female fish to release their eggs. Since the number of fish species studies so far is low, the question arises as to whether the available data are representative for fish in general. The high survival rate and prompt restoration of the drop in osmolarity after sudden and severe water acidification seems to be an exception rather than the rule. The type of responses observed, however, in particular the activation of cells producing osmoregulatory hormones and the reduction of growth hormone cells, will undoubtedly occur in many other species. All available evidence indicates that at least the involvement of the pituitary/inter-renal axis in the physiological adaptation of fish to acid water is a general phenomenon. (See also W89-11837) (Lantz-PTT)
W89-11851

NATURE AND EXTENT OF MARINE CONTAMINATION CAUSED BY LAND-BASED SOURCES IN CANADA,
Department of Fisheries and Oceans, Vancouver (British Columbia). West Vancouver Lab.
For primary bibliographic entry see Field 5B.
W89-11857

OVERVIEW OF MARINE ENVIRONMENTAL QUALITY ISSUES ON THE ATLANTIC COAST OF CANADA,
Department of Fisheries and Oceans, Halifax (Nova Scotia). Halifax Fisheries Research Lab.
J. F. Uthe, and V. Zitko.
IN: Canadian Conference on Marine Environmental Quality: Proceedings, February 29-March 3, 1988, Halifax, Nova Scotia. The International Institute for Transportation and Ocean Policy Studies, 1236 Henry St., Halifax, Nova Scotia, Canada. 1988. p 199-208, 1 fig, 2 tab, 27 ref.

Descriptors: *Environmental quality, *Atlantic Ocean, *Coastal waters, *Commercial fishing, *Marine environment, *Canada, *Water pollution effects, *Water pollution sources, Industrial wastewater, Fisheries, Continental shelf, Environmental effects.

The Atlantic area of Canada with its relatively small population and industrial density has the largest commercial fishery and the largest continental shelf area in Canada. The marine environment receives contaminant inputs from local sources and by long-range aerial and fluvial transport. Important sources of contamination from land include mining, the pulp and paper industry, wood preservation, sewage, and agriculture. In both cases the contaminants range from individual chemicals to ill-defined mixtures. A variety of contaminants affect the fishery, such as trace metals, stable organics (including pesticides), fossil fuels and their products, and nutrients. The current state of knowledge of the environmental effects of contaminants is discussed. Effects on the fishery are of three types: those affecting the production of fish; those affecting the wholesomeness of fishery products; and those affecting the fishing industry itself such as gear fouling. Many problems have been solved but others remain, and unexpected problems may occur now and again. (See also W89-11852) (Author's abstract)
W89-11863

TOXICOLOGY--A PRIMER ON TOXICOLOGY PRINCIPLES AND APPLICATIONS.
Michigan State Univ., East Lansing. Dept. of Economics.
M. A. Kamrin.
Lewis Publishers, Chelsea, Michigan. 1988. 145p.

Descriptors: *Pollutant identification, *Toxicology, *Water pollution effects, *Toxicity, Drinking water, Public health, DDT, Polychlorinated biphenyls, Dioxins, Pesticides, Environmental effects, Risk assessment, Population exposure, Water pollution treatment, Toxaphenes, Case studies, Asbestos, Benzenes.

As the use of synthetic chemicals increased dramatically after World War II, concern about the possible adverse health and environmental effects of such use grew. Chemicals, such as dioxin and toxaphene, DDT, PCB, and EDB, became familiar to everyone. Unfortunately, the rate at which chemicals were developed and distributed was not matched by the rate of increased scientific or public understanding. The purpose of this book is to familiarize the reader with the current knowledge of toxicology and with how society uses this understanding in managing toxic substances. The book opens with a discussion of the general principles of toxicology and how these general principles are applied in assessing the acute, subacute and chronic effects of chemicals. Both qualitative and quantitative measures of toxicity are addressed and the protocols for the various tests are described. Emphasis is placed on both the strengths and limitations of the techniques which are in current use. This is then followed by a discussion of risk assessment and risk management. Risk assessment deals with both the toxic potential of a chemical and the exposure likely to occur in specific situations. Risk management includes the steps taken to reduce or eliminate risks identified in the assessment process. The components of risk assessment are described in relation to a variety of possible toxic effects and exposure scenarios. The last part of the book provides a description and analysis of four case studies, each dealing with a different substance. These include the food additives, cyclamate and saccharin; the fire retardant material, asbestos; the widely-used formaldehyde; and the petroleum product, benzene. The basic toxicological information regarding each, and the different regulations to which they have been subject, provide the basis for exploring how the principles introduced in the first part of the book are applied in practice. (Lantz-PTT)
W89-11896

WHAT WE LEARNED FROM THE RHINE.
Fawcett Consultants, Inc., Wheaton, MD.
For primary bibliographic entry see Field 5B.
W89-11903

PRELIMINARY ASSESSMENT OF THE EFFECTS OF SUBSURFACE SEWAGE SLUDGE DISPOSAL ON GROUNDWATER QUALITY,
D. C. Mosher.
IN: Design Seminar Handout: Sludge Treatment and Disposal. Environmental Protection Agency Environmental Research Information Center Technology Transfer, 1977. p 210-227, 3 fig, 4 tab, 3 ref. EPA Contract 68-01-3108.

Descriptors: *Groundwater quality, *Sludge disposal, *Water pollution effects, *Underground waste disposal, Hydrogen ion concentration, Biochemical oxygen demand, Municipal wastewater, Heavy metals, Sludge, Groundwater pollution, Municipal wastes, Solid wastes, California, Leachates, Chlorides, Nitrogen compounds, Administrative agencies.

A study conducted at Oceanside, CA, on leachate from municipal solid waste and mixed sewage sludge/municipal solid waste was completed in 1973. This study concluded that other than a lower pH and higher biochemical oxygen demand (BOD) in the leachate from mixed sewage sludge/municipal solid waste no other differences occurred. A continuing study of sewage sludge only disposal was initiated in 1974 by the U.S. Department of Agriculture (USDA). The data from this study shows groundwater has been affected after only 19 months. The testing was limited to chloride and nitrogen compounds. These studies did not allow projection of the total effect of subsurface sewage sludge disposal on groundwater resources. The Oceanside study, for example, was limited to leachate analysis only. This data then could only yield a determination of potential pollutants. The USDA study did not include analysis for toxic metals. Toxic metals analysis at the USDA field plots will be started in the near future. Sewage sludges, however, are being generated in ever increasing quantities and state regulatory agencies must determine what methods of sludge disposal are acceptable. In order to provide a broader data base on which to issue guidance to state regulatory agencies, EPA awarded a contract to monitor the effects of subsurface sewage sludge disposal on groundwater quality. This paper briefly describes and reports the results (in tabular form) of the study, drawing comparisons where appropriate, to a similar and somewhat more comprehensive study of municipal solid waste only sites. (See also W89-11908) (Lantz-PTT)
W89-11914

SEPTIC TANKS AND THEIR EFFECTS ON THE ENVIRONMENT.
California Univ., Berkeley. Sanitary Engineering Research Lab.
For primary bibliographic entry see Field 5D.
W89-11957

EXPLICATION OF HEALTH ASSESSMENT,
Agency for Toxic Substances and Disease Registry, Atlanta, GA.
L. J. Hutchinson, and J. E. Abraham.
IN: HWHM 88: Hazardous Wastes and Hazardous Materials. Proceedings of the 5th National Conference held April 19-21, 1988, Las Vegas, Nevada. 1988. p 386-388, 6 ref.

Descriptors: *Health assessment, *Risk assessment, *Public health, *Water pollution effects, Management planning, Toxicity, Hazardous wastes, Case studies, Lead, Arsenic, Cadmium.

Health assessment differs from risk assessment in purpose, approach, performance, content and context Health assessment developed from public health, which, in turn, developed from medicine. The holistic model of clinical evaluation, which stresses integration of multiple avenues of investigation, provides an apt analogy to the evaluation of human health risks from toxic waste sites. A

holistic paradigm provides a framework that structures thinking to facilitate more effective risk communication practices and more comprehensive evaluation of human health risks. The approach, purposes and uses of health assessment are explained. Two case studies are given: (1) Mill Creek, Mt, located near a former copper smelter; and (2) California Gulch Site in Leadville, CO, a former mining site. EPA sampling at the smelter site show exposure to arsenic, cadmium, and lead in the drinking water. The health assessment included consideration of health effects more subtle than cancer which might occur earlier, at lower exposure levels, and with lower total body burdens. As a result of this study the site was condemned and the community evacuated. At the Colorado site there was contamination of shallow wells and surface water and acute fish and plant toxicity but the harsh winter conditions that exist for up to 6 mos. may mitigate actual exposure. The health assessment for this site recommended an exposure assessment to measure actual lead body burdens as an indication of overall lead intake and accumulation in exposed residents. (See also W89-12002) (Lantz-PTT)
W89-12054

REVIEW AND EVALUATION OF CHEMICAL CONCENTRATION DATA FOR USE IN SUPERFUND PUBLIC HEALTH EVALUATIONS.
ICF-Clement, Washington, DC.
For primary bibliographic entry see Field 7C.
W89-12056

FOOD CHAIN EXPOSURE ASSESSMENTS: A MULTI-SPECIES APPROACH.
Jordan (Edward C.) Co., Inc., Wakefield, MA.
M. J. Donato, and A. H. Baldwin.
IN: HWHM 88: Hazardous Wastes and Hazardous Materials. Proceedings of the 5th National Conference held April 19-21, 1988, Las Vegas, Nevada. 1988. p 487-493, 5 fig, 3 tab, 16 ref. EPA Contract 68-02-7250.

Descriptors: *Toxicity, *Food chains, *Water pollution effects, *Risk assessment, Aquatic environment, Aquatic life, Biological studies, Benthic environment, Quantitative analysis, Environmental effects.

Assessment of impacts to aquatic organisms and food chains caused by environmental contaminants is becoming an increasingly important component of remedial investigations, risk/endangerment assessments, feasibility studies and other environmental evaluations aimed at finding environmentally sound solutions to hazardous waste problems. A methodology is proposed that goes beyond single species/single toxicant exposure assessments to examine exposures at different trophic levels as well as to individual aquatic organisms within the food chain. The first step is to identify and characterize the aquatic environments near the site of concern, such as rivers, lakes and ponds. The second step is to choose a subset of species based on parameters such as species commonality, food chain function and availability of ecotoxicity data. The third step involves development of two food chains representative of benthic and pelagic communities, which involves compilation of life-cycle and natural history (ecological) data. The purpose of the fourth, or toxicological assessment step, is compilation of ecotoxicity data (species specific) in order to determine dose or concentration-response relationships. In the final step data generated in the previous steps are combined to characterize the impacts to the individual aquatic organisms and the aquatic food chains at risk. Using this methodology, it is possible to address the risks associated with exposure to hazardous waste constituents not only to individual organisms but also entire food chains, allowing a semi-quantitative and qualitative assessment of current and future impacts from exposure. This level of detail provides the necessary information upon which to base sound engineering decisions in the development and evaluation of remedial alternatives. (See also W89-12002) (Author's abstract)
W89-12068

HEALTH RISK ASSESSMENT OF CARBON TETRACHLORIDE (CTC) IN CALIFORNIA DRINKING WATER.
California Univ., Davis. Dept. of Environmental Toxicology.
N. R. Reed, R. Babapour, W. Reed, L. Beltran, and D. P. H. Hsieh.
Available from the National Technical Information Service, Springfield, VA 22161, as PB89-102321. Price codes: A06 in paper copy, A01 in microfiche. Report No. UCD/ET-88/1, May 17, 1988. 157p, 5 fig, 19 tab, 244 ref, append. State of California Contract 84-84571.

Descriptors: *Risk assessment, *Carbon tetrachloride, *Drinking water, *Water quality, *Public health, California, Toxicity, Literature review, Carcinogens, Population exposure.

The purpose of this document is to provide information on the toxicity of carbon tetrachloride (CTC) and to estimate the exposure of California residents to CTC. The information provided will aid the California Department of Health Services (CDHS) in developing drinking water standards for CTC. The four major contributions of this document are: (1) a review of the existing literature pertinent to the health risk posed by the use of CTC contaminated drinking water; (2) an estimation of the CTC exposure for California residents based on the most recent data on CTC concentrations in California drinking water supplies; (3) a delineation of the level of CTC that may cause a noncarcinogenic health effect; and (4) an estimation of the cancer potency, dose level, and concentration of CTC in water associated with a lifetime cancer risk. The following topics are also discussed: physical and chemical properties, mechanisms of toxicity and toxicokinetics, human exposure, health effects in animals and humans; quantification of toxicological effects; and data gaps. (Author's abstract)
W89-12096

1987 ANNUAL SITE ENVIRONMENTAL REPORT FOR ARGONNE NATIONAL LABORATORY.
Argonne National Lab., IL. Environment, Safety and Health Dept.
For primary bibliographic entry see Field 5B.
W89-12108

FIELD AND LABORATORY STUDY USING ADENYLATE ENERGY CHARGE AS AN INDICATOR OF STRESS IN MYTILUS EDULIS AND NEPHYTYS INCISA TREATED WITH DREDGED MATERIAL.
Environmental Research Lab., Narragansett, RI.
For primary bibliographic entry see Field 5A.
W89-12110

PLAN FOR STUDY: RESPONSE OF THE HABITAT AND BIOTA OF THE INNER NEW YORK BIGHT TO ABATEMENT OF SEWAGE SLUDGE DUMPING.
National Marine Fisheries Service, Woods Hole, MA. Northeast Fisheries Center.
For primary bibliographic entry see Field 5G.
W89-12111

SEWAGE EFFECTS IN MARINE AND ESTUARINE ENVIRONMENTS, JANUARY, 1977-MARCH, 1988: CITATIONS FROM THE NTIS BIBLIOGRAPHIC DATABASE.
National Technical Information Service, Springfield, VA.
Available from National Technical Information Service, Springfield, VA 22161 as PB88-861315, Price codes: N01 in paper copy, N01 in microfiche. April 1988. 100p. Supersedes PB87-851564.

Descriptors: *Water pollution effects, *Bibliographies, *Estuaries, *Wastewater pollution, Sludge, Ocean dumping, Marine environment, Wastewater outfall.

This bibliography contains citations concerning the effects of disposal of sewage effluents and sludge on marine and estuarine environments. The effects on specific flora and fauna, ocean dumping problems and pollutant distribution analyses are among the topics considered. Regional and site specific studies regarding environmental effects of ocean waste disposal are presented. This updated bibliography contains 309 citations of which 54 are new entries to the previous edition. (Author's abstract)
W89-12141

TOXICITY BIOASSAYS: WATER POLLUTION EFFECTS ON AQUATIC ANIMALS AND PLANTS, JUNE 1986-MAY 1988: CITATIONS FROM THE SELECTED WATER RESOURCES ABSTRACTS DATABASE.
National Technical Information Service, Springfield, VA.
Available from National Technical Information Service, Springfield, VA 22161 as PB88-863907, Price codes: N01 in paper copy, N01 in microfiche. April 1988. 26p. Supersedes PB87-861100.

Descriptors: *Water pollution effects, *Bibliographies, *Toxicity, *Bioassay, Mortality, Industrial wastewater, Agricultural runoff, Metals, Pesticides, Herbicides, Agricultural chemicals.

This bibliography contains citations concerning toxicity bioassay studies of water pollution effects on reproduction, growth, and mortality of aquatic animals and plants. Industrial and agricultural water pollutants such as metals, chemicals, pesticides, and herbicides are evaluated and tested. Standard fishes and algal assays are used to determine effects of potential toxicants. This updated bibliography contains 62 citation of which 12 are new entries to the previous edition. (Author's abstract)
W89-12143

PESTICIDE TOXICITY IN FRESHWATER FISH, JANUARY 1978-MAY 1988: CITATIONS FROM THE LIFE SCIENCES COLLECTION DATABASE.
National Technical Information Service, Springfield, VA.
Available from National Technical Information Service, Springfield, VA 22161 as PB88-865571, Price codes: N01 in paper copy, N01 in microfiche. June 1988. 99p. Supersedes PB87-851432.

Descriptors: *Water pollution effects, *Bibliographies, *Pesticide toxicity, *Fish, Agricultural chemicals, Insecticides, Algicides, Fungicides, Herbicides, Bioassay, Fish physiology, Trout, Catfish, Carp, Bluegills, Bass.

This bibliography contains citations concerning determinations, research, causes, effects, and control of pesticide toxicity in freshwater fish. Bioaccumulation of toxic substances and assay methods to determine their effects are considered. The toxicology of freshwater fish to specific insecticides, algicides, fungicides, and herbicides is discussed. Various species of freshwater fish are examined, including brook and lake trout, catfish, carp, bluegill, and bass. This updated bibliography contains 299 citations of which 178 are new entries to the previous edition. (Author's abstract)
W89-12152

OIL SPILLS: BIOLOGICAL EFFECTS, JUNE 1981 TO FEBRUARY 1988: CITATIONS FROM THE NTIS BIBLIOGRAPHIC DATABASE.
National Technical Information Service, Springfield, VA.
Available from National Technical Information Service, Springfield, VA 22161 as PB88-858931, Price codes: N01 in paper copy, N01 in microfiche. March 1988. 44p. Supersedes PB82-810391.

Descriptors: *Oil spills, *Bibliographies, *Water pollution effects, Ecological effects, Model studies, Environmental impact statement.

This bibliography contains citations concerning the biological and ecological effects of oil spills. The effects on microorganisms, plants, and animals are studied. Damage assessment, ecological modeling, and environmental impact statements are included.

This updated bibliography contains 152 citations of which 29 are new entries to the previous edition. (Author's abstract)
W89-12157

DREDGING: BIOLOGICAL EFFECTS, JANUARY 1979-FEBRUARY 1988: CITATIONS FROM THE NTIS BIBLIOGRAPHIC DATABASE.
National Technical Information Service, Springfield, VA.
For primary bibliographic entry see Field 6G.
W89-12160

POLYCHLORINATED BIPHENYLS IN THE FRESHWATER ENVIRONMENT, JANUARY 1977-JANUARY 1988: CITATIONS FROM THE SELECTED WATER RESOURCES ABSTRACTS DATABASE.
National Technical Information Service, Springfield, VA.
Available from National Technical Information Service, Springfield, VA 22161 as PB88-857156, Price codes: N01 in paper copy, N01 in microfiche. January 1988. 93p. Supersedes PB87-855094.

Descriptors: *Polychlorinated biphenyls, *Bibliographies, *Water pollution effects, *Water pollution sources, *Pollutant identification, Path of pollutants, Bioaccumulation, Food chains, Monitoring, Sediments, Fish, Toxicity, Chlorinated hydrocarbons, Pesticides.

This bibliography contains citations concerning the occurrence and effects of polychlorinated biphenyls in the freshwater environment. topics include sources, distribution, and accumulation rates for specific regions, bioaccumulation, pollutant paths and introduction into the food chain, and results of long and short term monitoring of selected areas. Detection methods for PCB accumulation in fish and surficial sediments are also considered. This updated bibliography contains 239 citations of which 19 are new entries to the previous edition. (Author's abstract)
W89-12170

5D. Waste Treatment Processes

EFFECTS OF INTERACTIONS WITHIN A THREE-MEMBERED MICROBIAL COMMUNITY ON THE KINETICS OF DUAL SUBSTRATE REMOVAL IN CONTINUOUS CULTURE.
Clemson Univ., SC. Dept. of Environmental Systems Engineering.
Y. Lu, and C. P. L. Grady.
Water Science and Technology WSTED4, Vol. 20, No. 11/12, p 11-16, 1988. 3 fig, 1 tab, 12 ref. NSF Grant CEE-8116870.

Descriptors: *Microbiological studies, *Bacterial physiology, *Wastewater treatment, *Biological wastewater treatment, *Wastewater dilution, *Bacteria, Biodegradation, Wastewater disposal, Metabolism, Substrates, Population dynamics, Population density, Enzymes, Culturing techniques, Chlorophenols, Lysine.

The effects of reactor dilution rate on the removal of xenobiotic compounds from wastewater in a biological treatment system were investigated. A bacterial community containing two specialists (a 2-chlorophenol specialist, named the CP organism, and a lysine specialist, termed L2 Organism) and a generalist capable of metabolizing both 2-chorophenol and lysine (called the I1 organism), was grown in continuous culture at three dilution rates on a feed containing L-lysine and 2-chlorophenol (2-CP) as the only carbon sources. The lysine degrading specialist maintained stable but oscillatory numbers whereas the generalist declined in number throughout each experiment. The 2-CP degrading specialist initially washed out of the culture, but then increased in number over time. I1 maintained relatively constant numbers. However, once the 2-CP, specialist began to grow, the generalist went into decline and in the case of the lowest dilution rate, was almost totally washed out. The fact that the numbers of L2 did not change as the numbers of I1 declined suggests that a substantial proportion of the lysine was being used by L2. This suggest that I1 was subsisting primarily on 2-CP, in spite of its ability to use both substrates, and thus as CP organism began to grow, it outcompeted I1 for the 2-CP, thereby causing a marked decline in the number of I1 organisms present. The major impact of lower dilution rates was to extend the experimental time available after synthesis of required enzymes by the 2-CP specialist. Thus, it is possible that the same degree of loss of the generalist would have been observed at all dilution rates. (Friedmann-PTT)
W89-11071

DIVERSITY OF ACTIVATED SLUDGE MICROBIAL COMMUNITIES AS DESCRIBED BY THE FUNDAMENTAL NICHE CONCEPT,
CH2M/Hill, Denver, CO.
T. J. Simpkin.
Water Science and Technology WSTED4, Vol. 20, No. 11/12, p 39-44, 1988. 3 fig, 6 ref.

Descriptors: *Species diversity, *Niches, *Ecosystems, *Wastewater treatment, *Activated sludge, *Sludge, *Microorganisms, Substrates, Microenvironment, Population dynamics, Succession, Hydrogen ion concentration, Dissolved oxygen, Temperature, Flocculation, Microbiological studies.

The fundamental niche concept provides a means of describing the structure and diversity of an activated sludge microbial community. The fundamental niche is the complete set of environmental conditions under which an organism may successfully replace itself. The concept explains community diversity by describing the many traits of each microorganism species and how these traits may or may not be involved in providing the mechanism for the species to proliferate in a given environment. The utility of this concept arises when the fundamental niches of two species are compared to the environment they live in and to each other. The environment can be described with a hypervolume similar to that of a fundamental niche. For example, two dimensions that may make up this hypervolume are the pH and dissolved oxygen range of the environment. If the environmental and fundamental niche hypervolumes are superimposed, an area of overlap may exist. The microorganism will only survive in the environment if an overlap exists. An application of the fundamental niche concept is presented through the hypervolume describing the environment of an activated sludge system. The size of the environment hypervolume of the typical activated sludge hypervolume is very extensive, including dissolved oxygen concentration, pH, temperature, substrate type, substrate concentration, and location within the floc particle. It is thus possible that the fundamental niches of numerous microorganisms will fill part of the volume without overlapping each other; consequently, activated sludge microbial communities can be very diverse. (Friedmann-PTT)
W89-11075

THEORETICAL AND EXPERIMENTAL ANALYSIS OF PSEUDOMONAS AERUGINOSA BIOFILM.
Montana State Univ., Bozeman. Inst. for Biological and Chemical Process Analysis.
W. G. Characklis, R. Bakke, and M. H. Turakhia.
Water Science and Technology WSTED4, Vol. 20, No. 11/12, p 45-51, 1988. 5 fig, 1 tab, 9 ref. NSF grant CBT-842078, Office of Naval Research Grant N00014-84-K-0309.

Descriptors: *Biofilms, *Wastewater treatment, *Mathematical models, *Bacterial analysis, *Pseudomonas, Model studies, Substrates, Bacteria, Population dynamics, Growth rates, Theoretical analysis, Prediction.

A mathematical model for accumulation and activity of Pseudomonas and aeruginosa biofilm and based on conservation principles, transport phenomena, and fundamental kinetic and stoichiometric relationships is presented. The validity of the model was tested by comparing theoretical predictions to experimental data. Experimental data from chemostat experiments were used successfully to predict progression of several variables in a biofilm reactor. Model predictions, presented in terms of the effects of a few important variables on biofilm accumulation and activity, include progression of substrate removal, cellular accumulation, and extracellular polymer accumulation in the bulk water and in the biofilm. The model includes calculations of specific growth rate, specific extracellular polymeric substances (EPS) formation rate, and specific detachment (erosion) rate. Material balances are calculated for substrate carbon, suspended cell carbon, suspended product carbon, biofilm cell carbon, and biofilm polymer carbon. Constant cellular and EPS volumetric densities ar assumed for the biofilm. The results from a Psuedomonas aeruginosa biofilm were consistent with earlier chemostat data, and indicate that the energy metabolism of Pseudomonas aeruginosa in a biofilm state is the same as in the planktonic state. (Friedmann-PTT)
W89-11076

ESTIMATION OF UNBALANCED BACTERIAL GROWTH IN INHIBITORY ENVIRONMENTS BY PHYSIOLOGICAL ASSESSMENT.
Kanazawa Univ. (Japan). Dept. of Chemical Engineering.
For primary bibliographic entry see Field 2H.
W89-11077

BIODEGRADATION OF CARBAMATES.
Florida Univ., Gainesville. Dept. of Soil Science.
G. R. Chaudhry, and W. B. Wheeler.
Water Science and Technology WSTED4, Vol. 20, No. 11/12, p 89-94, 1988. 3 fig, 1 tab, 12 ref.

Descriptors: *Decontamination, *Wastewater treatment, *Path of pollutants, *Wastewater treatment, *Biodegradation, *Pseudomonas, *Fate of pollutants, *Carbamate pesticides, Organic compounds, Groundwater pollution, Bacteria, Water quality control.

A carbofuran-metabolizing Pseudomonas sp. was investigated for its capability to degrade some other carbamates and its effectiveness as a decontaminant for carbamate-polluted water samples. The organism degraded both aldicarb and carbaryl. It also decontaminated carbofuran-fortified water samples from various sources in the absence of additional nutrients under laboratory conditions. This microorganism harbored several plasmids that may be involved in the degradation of carbamates. This investigatation has shown that pseudomonas sp. may potentially be used for biological treatment of wastewater and polluted groundwater. (Author's abstract)
W89-11081

UTILIZATION OF IMMOBILIZED-BACTERIA TO DEGRADE AROMATIC COMPOUNDS COMMON TO WOOD-TREATMENT WASTEWATERS.
Idaho Univ., Moscow. Dept. of Bacteriology and Biochemistry.
K. T. O'Reilly, R. Kadakia, R. A. Korus, and R. L. Crawford.
Water Science and Technology WSTED4, Vol. 20, No. 11/12, p 95-100, 1988. 20 ref.

Descriptors: *Microbial degradation, *Aromatic compounds, *Wood wastes, *Bacteria, *Wastewater treatment, *Biodegradation, Water pollution control, Biological wastewater treatment, Toxins, Hydrocarbons, Phenols, Degradation.

The utilization of immobilized bacterial cells to remove toxic compounds from contaminated water is reviewed. A microbial biofilm capable of degrading the wood preservative pentachlorophenol (PCP) was developed in an aquatic system exposed to the biocide. The ability of the biofilm to function in a variety of bioreactors was tested. PCP and other aromatic compounds were degraded in the reactors. Large-scale bioreactors developed following these initial studies are currently in operation decontaminating water associated with wood-treatment facilities. Pure cultures of bacteria

capable of degrading PCP or p-cresol have been immobilized in calcium alginate. Complete degradation of the target compounds occurred in both batch and continuous bioreactors. Studies indicated that it should be possible to customize bioreactors for decontamination of specific waste streams by immobilizing the proper bacteria. (Author's abstract)
W89-11082

ACTIVATED SLUDGE TREATMENT OF ETHOXYLATE SURFACTANTS AT HIGH INDUSTRIAL USE CONCENTRATIONS.
Shell Development Co., Houston, TX.
J. P. Salanitro, G. C. Langston, P. B. Dorn, and L. Kravetz.
Water Science and Technology WSTED4, Vol. 20, No. 11/12, p 125-130, 1988. 5 fig, 1 tab, 12 ref.

Descriptors: *Activated sludge process, *Industrial wastes, *Biological wastewater treatment, *Degradation, *Surfactants, *Wastewater treatment, Primary wastewater treatment, Aeration, Foam separation, Primary sludge.

The primary degradation of linear alcohol ethoxylate (AE) and a branched nonylphenol ethoxylate (NPE) was investigated in bench-scale activated sludge units treating a synthetic sewage feed. Biotreaters were gradually adapted to 10-100 mg/l surfactant and effluents monitored for loss of nonionic ethoxylate, foaming, feed BOD removal, nitrification and biosolids growth. Both surfactants were degraded at influent doses of 10-40 mg/l. Substantial BOD breakthrough, loss of nitrification, aerator foaming and incomplete removal of the NPE surfactant occurred when fed at 80 and 100 mg/l while the unit treating AE was unaffected by high surfactant levels. Comparative toxicity of the biotreated waste at high surfactant levels indicated that the NPE effluent was acutely toxic (EC50, 7-15% effluent) to the fathead minnow and Daphnia while that of the AE unit was non-toxic (EC50, > 100% effluent) to these same species. These studies indicate that the treatment of wastes containing high levels of NPE ethoxylates may adversely impact an activated sludge process in incomplete degradation and foaming, impaired BOD removal, loss in nitrification and the formation of toxic effluents. AE surfactants, however, undergo extensive microbial degradation and cause little or no impact on the activated sludge treatment process. (Author's abstract)
W89-11086

IMPACT OF CHEMOSTAT DISCHARGE CONTAINING OIL DEGRADING BACTERIA ON THE BIOLOGICAL KINETICS OF A REFINERY ACTIVATED SLUDGE PROCESS,
Sybron Chemicals, Inc., Salem, VA.
A. D. Wong, and C. D. Goldsmith.
Water Science and Technology WSTED4, Vol. 20, No. 11/12, p 131-136, 1988. 5 fig, 2 tab, 5 ref.

Descriptors: *Industrial wastes, *Oil wastes, *Activated sludge process, *Biodegradation, *Oil, *Bacteria, *Oil refineries, *Wastewater treatment, *Chemical wastes, Kinetics, Water pollution effects, Effluents, Organic wastes, Degradation.

The effect of discharging specific oil degrading bacteria from a chemostat to a refinery activated sludge process was determined biokinetically. Plant data for the kinetic evaluation of the waste treatment plant was collected before and during treatment. During treatment, the 500 gallon chemostatic growth chamber was operated on an eight hr hydraulic retention time, at a neutral pH, and was fed a mixture of refinery wastewater and simple sugars. The biokinetic constants k (/days), K sub s (mg/L), and K (L/mg-day) were determined before and after treatment by Monod and Lineweaver-Burk plots. Solids discharged and effluent organic concentrations were also evaluated against the mean cell retention time (MCRT). The maximum utilization rate, k, was found to increase from 0.47 to 0.95/days during the operation of the chemostat. Subsequently, K sub s increased from 141 to 556 mg/L. Effluent solids were shown to increase slightly with treatment. However, this was acceptable due to the polishing pond and the benefit of increased ability to accept shock loads of oily wastewater. The reason for the increased suspended solids in the effluent was most likely due to the continual addition of bacteria in exponential growth that were capable of responding to excess substrate. The effect of the chemostatic addition of specific microbial inocula to the refinery waste treatment plant has been to improve the overall organic removal capacity along with subsequent gains in plant stability. (Author's abstract)
W89-11087

TOXICITY TESTING IN WASTEWATER SYSTEMS: APPLICATION OF A SHORT-TERM ASSAY BASED ON INDUCTION OF THE LAC OPERON IN E. COLI.
Florida Univ., Gainesville. Dept. of Environmental Engineering Sciences.
For primary bibliographic entry see Field 5A.
W89-11088

RECOMBINANT DNA PLASMID TRANSMISSION TO INDIGENOUS ORGANISMS DURING WASTE TREATMENT.
Drexel Univ., Philadelphia, PA. Dept. of Bioscience and Biotechnology.
For primary bibliographic entry see Field 5B.
W89-11094

PROTOZOA AND METAZOA AS INDICATORS OF EFFLUENT QUALITY IN ROTATING BIOLOGICAL CONTACTORS.
New Hampshire Univ., Durham. Dept. of Civil Engineering.
N. E. Kinner, C. R. Curds, and L. D. Meeker.
Water Science and Technology WSTED4, Vol. 20, No. 11/12, p 199-204, 1988. 3 fig, 1 tab, 7 ref. NATO grant 213/84.

Descriptors: *Quality control, *Protozoa, *Pollutant identification, *Bioindicators, *Wastewater treatment, *Biological wastewater treatment, Effluents, Microorganisms, Substrates, Species diversity, Microscopic analysis, Water quality standards.

In situ biofilm, incubation slide and freezing techniques were used to investigate the diversity of protozoan and metazoan populations inhabiting rotating biological contractor (RBC) biofilms in relationship to effluent quality during different seasons of the year at two treatment plants. The in situ biofilm techniques yielded the best results primarily because samples contained higher numbers of individuals per species and were easier to obtain. A protocol based on 2 microscopic scans (200 times magnification) across a total width of a covership on each of 3 slides is proposed as a cost-effective procedure for discriminating among three classifications of effluent quality (Good: BOD sub 5 < or = 25 mg/l, Fair: BOD sub 5 = 26-40 mg/l, Poor: BOD sub 5 > 40 mg/l) based on the populations of organisms inhabiting RBC biofilms. (Author's abstract)
W89-11097

ECOLOGICAL STUDY ON ANAEROBIC SLUDGE BULKING CAUSED BY FILAMENTOUS BACTERIAL GROWTH IN AN ANAEROBIC CONTACT PROCESS.
Tohoku Gakuin Univ., Sendai (Japan). Dept. of Civil Engineering.
G. Endo, and Y. Tohya.
Water Science and Technology WSTED4, Vol. 20, No. 11/12, p 205-211, 1988. 5 fig, 2 tab, 4 ref.

Descriptors: *Filamentous bacteria, *Microbiological studies, *Contactors, *Bulking sludge, *Wastewater treatment, *Anaerobic conditions, *Activated sludge process, Growth rates, Contact beds, Fermentation, Biomass, Sludge, Anaerobic bacteria.

A biological bulking phenomenon, caused by filamentously growing anaerobic microorganisms in experimental anaerobic contact processes (ACP) treating wheat starch wastewater, was observed. There are many kinds of anaerobic microorganisms that grow filamentously, e.g. those in activated sludge. One species of anaerobic bacteria caused serious sludge bulking, and it had thin rods (around 0.2 microns in width) and long chained morphology. When acidogenically fermented starch wastewater was fed to the ACP, the thin rod microorganism was eliminated and the biomass concentration of the methanogenic fermentor was recovered. The microorganism that caused bulking phenomenon was enriched in a liquid medium containing raw starch (wheat starch particle). The microorganism grew in long chained filamentous form, degraded raw starch, and fermented mainly volatile fatty acids (acetate, propionate, butyrate and ethanol. From these results, it is revealed that acidogenic fermentation of wastewater containing raw starch prior to treatment by an ACP is effective in preventing the anaerobic sludge bulking and in keeping high organic loading of ACPs. (Author's abstract)
W89-11098

DETERMINATION OF ACTIVE BIOMASS.
Technical Univ. of Denmark, Lyngby. Dept. of Sanitary Engineering.
B. K. Jensen, T. Eriksen, and P. E. Jorgensen.
Water Science and Technology WSTED4, Vol. 20, No. 11/12, p 213-219, 1988. 2 fig, 3 tab, 15 ref.

Descriptors: *Pollutant identification, *Biomass, *Wastewater treatment, *Groundwater pollution, Microorganisms, Growth media, Biological wastewater treatment, Substrates, Oxygen requirements, Bacteria, Adenosine triphosphate.

Reliable techniques for determination of active biomass are fundamental to both wastewater treatment and groundwater contaminant prediction and modeling. In growth cultures of wastewater, adenosine triphosphate (ATP) content and optical density (OD) were compared to O2 consumption rates and FDA hydrolysis. In groundwater, Acridine Orange Direct Counts, ATP, undiluted and ten times diluted plate counts were compared to Vmax values for acetate, glucose and naphthalene. To evaluate the reliability of the obtained results, they were compared to corresponding microbial activity parameters. The wastewater studies involved growth cultures prepared by inoculating a synthetic medium with wastewater bacteria. In the maximum growth phase of these growth cultures, a high correlation was found between ATP, OD, O2 consumption and FDA hydrolysis. The latter, however, considerably overestimated the biomass when applied to untreated wastewater samples. Plate counts, and especially ATP content, showed fairly good correlation with microbial activity. It is thus concluded that ATP is considered to be superior to the other biomass parameters tested as a general applicable biomass parameter in wastewater and groundwater. (Author's abstract)
W89-11099

BIOCHEMICAL METHODS FOR AUTOMATED BACTERIAL IDENTIFICATION AND TESTING METABOLIC ACTIVITIES IN WATER AND WASTEWATER.
Technische Univ. Berlin (Germany, F.R.). Dept. of Hygiene.
For primary bibliographic entry see Field 7B.
W89-11100

MORPHOLOGY, PHYSIOLOGY, AND NUTRITION OF A SULFUR-OXIDIZING FILAMENTOUS ORGANISM ISOLATED FROM ACTIVATED SLUDGE.
Yamanashi Univ., Kofu (Japan). Dept. of Environmental Engineering.
T. Kohno.
Water Science and Technology WSTED4, Vol. 20, No. 11/12, p 241-247, 1988. 3 fig, 4 tab, 12 ref.

Descriptors: *Wastewater treatment, *Sulfur bacteria, *Filamentous bacteria, *Wastewater analysis, *Bulking sludge, *Activated sludge, *Microorganisms, *Wastewater, *Bacterial physiology, Culturing techniques, Aerobic conditions, Morphology, Nutrition.

A chief causative filamentous organism of sewage sludge bulking was examined. The organism was

very similar to 021N in many morphological and physiological features. Its filaments were Gram-negative, and had a thin fragile sheath-like structure outside the cells. All its isolates were oxidase-positive, but were positive or negative for catalase. The organism grew under strictly aerobic conditions, and grew well under slightly alkaline pH at temperatures of 20-30C. Good carbon sources were glucose, fructose, alpha-glycoside, oligosaccharides of glucose and/or fructose, acetic acid, and beta-hydroxybutylic acid. Ammonia was a good nitrogen source. This organism could utilize thiosulphate as an energy source, but failed to oxidize the compound when acetic acid was available in batch culture. (Author's abstract)
W89-11103

EFFECT OF CONTROLLED PH ON THE DEVELOPMENT OF ROSETTE-FORMING BACTERIA IN AXENIC CULTURE AND BULKING ACTIVATED SLUDGE,
Pennsylvania State Univ., University Park. Dept. of Civil Engineering.
R. F. Unz, and T. M. Williams.
Water Science and Technology WSTED4, Vol. 20, No. 11/12, p 249-255, 1988. 7 fig, 1 tab, 7 ref.

Descriptors: *Population dynamics, *Wastewater treatment, *Bulking sludge, *Activated sludge process, *Sewage bacteria, Bacteria, Sludge, Activated sludge, Microorganisms, Substrates, Biological wastewater treatment, Case studies, Culturing techniques, Sludge volume index, Hydrogen ion concentration.

A case history of an acute filamentous bulking episode that caused extreme sludge volume index and effluent suspended solids values is reviewed. An infestation of a rosette-forming microorganisms, with morphological characteristics bearing some resemblance to Eikelboom type 021N and Thiothrix spp., occurred in the activated sludge process of a paper and pulp manufacturing facility during the autumn of 1986 in Mehoopany, Pennsylvania. The microorganism could not be eliminated by periodic acid-shocking of the mixed liquor with sulfuric acid. However, exposure of the mixed liquor solids for 10 days at controlled pH (about 5.5) brought almost immediate lowering of the sludge volume index and effluent suspended solids to levels observed in normal operations. The bulking correction technique required no purchase of special chemicals in that the procedure was a mere modification of the liming step normally employed to bring the natural pH of the wastewater (pH 3) to a level suitable for the practice of biological treatment. (Author's abstract)
W89-11104

ISOLATION AND IDENTIFICATION OF ACTINOMYCETES PRESENT IN ACTIVATED SLUDGE SCUM.
Atlanta City Technical Services Branch, GA.
M. Sezgin, M. P. Lechevalier, and P. R. Karr.
Water Science and Technology WSTED4, Vol. 20, No. 11/12, p 257-263, 1988. 6 tab, 14 ref.

Descriptors: *Activated sludge process, *Biological wastewater treatment, *Scum, *Activated sludge, *Actinomyces, *Wastewater treatment, *Sewage bacteria, Bacteria, Microorganisms, Sludge, Isolation.

A number of activated sludge plants have experienced problems with a brown viscous scum that is caused by a group of organisms known as Actinomycetes. Because diversity of actinomyces in a sample has not yet been reported, a study was carried out to isolate and identify actinomycetes present in activated sludge scum. Samples from two activated sludge treatment plants were analyzed. One hundred five strains were isolated. The predominant organisms in both treatment plant samples was Nocardia amarae. Fifty-one strains of N. amarae were isolated. The second most common organisms (24 strains) was N. asteroides. The other isolates were identified as Rhodococcus coprophilus, R. equi, R. erythropolis, R. maris, Mycobacterium fortuitum, and strains belonging to the genera Nocardia, Rhodoccus, Oerskovia, Amycolatopsis and Micromonospora. Distribution of actinomycetes in the samples varied. This observation appeared to indicate that plant design, operational and environmental conditions might play an important role in determining the types of actinomycetes in aeration basins. (Author's abstract)
W89-11105

MICROBIAL COLONIZATION OF A SMOOTH SUBSTRATUM: A KINETIC ANALYSIS USING IMAGE ANALYSIS.
Montana State Univ., Bozeman. Inst. for Biological and Chemical Process Analysis.
For primary bibliographic entry see Field 2H.
W89-11108

MICROBIAL ECOSYSTEM IN PETROLEUM WASTE LAND TREATMENT,
University of Southern California, Los Angeles. Environmental Engineering Program.
T. R. Marshall, and J. S. Devinny.
Water Science and Technology WSTED4, Vol. 20, No. 11/12, p 285-291, 1988. 2 fig, 5 tab, 16 ref.

Descriptors: *Land disposal, *Soil bacteria, *Soil fungi, *Soil environment, *Wastewater treatment, *Microbial degradation, *Oil wastes, Petroleum products, Microenvironment, Biodegradation, Microorganisms, Culture media, Growth rates, Population dynamics, Fungi, Seasonal variation, Bacteria, Soil aggregates, Culturing techniques, Optimization, Cultivation.

Microbial populations, microbial activity and environmental conditions in an operating petroleum waste land treatment facility were monitored for an eighteen-month period. A modified most-probable number determination termed the plate-dilution frequency technique was used. Microdrop replicates (0.1 ml) were cultured on solid media from six members of a dilution series. Fungal counts were obtained using the same procedure and medium. Seasonal influences were observed for both bacterial and fungal populations. During cooler, wetter seasons, microbe populations were smaller, less variable and inhibited by the adverse environmental conditions. The hotter, drier months supported large, active populations that experienced large swings in number and respiratory output. Microenvironments within aggregates were also investigated. Analysis of various aggregate sizes revealed differences in population, activity and distribution of microorganisms. Soil aggregates created microenvironments that substantially differed from the bulk nature of the soil. Washing experiments indicated a population of bacteria at the surface of the aggregates that was readily removed. Fungi were somewhat less removable, and presumably occupy a microhabitat more firmly attached to the surfaces of the aggregates. Optimization of waste biodegradation in treatment soils requires monitoring the factors affecting the microbial community at the system level and an awareness of microenvironmental influences. Control of aggregate numbers and size, through tilling, may be a fruitful strategy for improving landfarm performance. (Friedmann-PTT)
W89-11109

DISINFECTION, RECONTAMINATION, AND REGROWTH OF INDICATOR BACTERIA IN A WASTEWATER SLUDGE HEAT TREATMENT SYSTEM.
Hawaii Univ., Honolulu. Water Resources Research Center.
R. S. Fujioka, W. M. Hirano, and P. C. Loh.
Water Science and Technology WSTED4, Vol. 20, No. 11/12, p 329-335, 1988. 2 tab, 7 ref.

Descriptors: *Contamination, *Heat treatment, *Wastewater treatment, *Bioindicators, *Wastewater treatment, *Disinfection, Coliforms, Clostridium, Growth media, Sludge cake, Substrates, Bacteria, Salmonella, Path of pollutants, Streptococcus, Pathogens, Viruses, Human pathogens.

The disinfection efficiency of the sludge heat treatment process is evaluated for the largest sewage treatment plant in Hawaii, which produces 25,400 kg/day of primary sludge that is heat-treated (190 C) under 330 psig for 30 min. Concentrations of total coliform (TC), fecal streptococcus (FS), and Clostridium perfringens (CP) in sludge were determined using the standard five-tube most probable number (MPN) method. The raw and heated sludge samples were measured by volume. Viruses were eluted from sludge samples, and the supernatant was then reconcentrated by acid precipitation and assayed for infectious human enteric viruses. The microbiological quality of the sludge cake was determined, and the reliability of the heat treatment of the sludge was determined for its consistency in disinfecting the sludge. The heat-treatment process was shown to disinfect the sludge by indicator bacteria. However, post contamination of the heat-treated sludge by raw sludge and by chlorinated primary effluent and the regrowth of indicator bacteria in the sludge storage tanks resulted in the presence of indicator bacteria in the sludge cake. Although the risk of using this sludge cake containing indicator bacteria is less than it appears, its reuse potential is still of concern since some pathogens such as Salmonella bacteria can be expected to multiply under the same conditions as coliforms. Thus, the three expedient practices used at this treatment plant, including (1) the use of chlorinated primary sewage effluent in the centrifugation process, (2) the filling of the heat exchangers and reactors with chlorinated effluent during the startup of the heat reactors, and (3) the occasional pumping of raw sludge via an emergency line to the treatment plant, which contribute to the contamination of the disinfected, heat-treated sludge, should be eliminated if the sludge cake is to be reused for human handling or exposure. (Friedmann-PTT)
W89-11115

DESTRUCTION OF SALMONELLAS, ENTEROVIRUSES AND OVA OF PARASITES IN WASTEWATER SLUDGE BY PASTEURIZATION AND ANAEROBIC DIGESTION.
Water Research Centre, Medmenham (England). Medmenham Lab.
E. B. Pike, E. G. Carrington, and S. A. Harman.
Water Science and Technology WSTED4, Vol. 20, No. 11/12, p 337-343, 1988. 4 tab, 12 ref.

Descriptors: *Anaerobic digestion, *Salmonella, *Enteroviruses, *Parasites, *Wastewater treatment, *Pasteurization, *Disinfection, *Nematodes, *Sludge digestion, Anaerobic conditions, Sludge, Bacteria, Viruses.

In laboratory experiments, Salmonella duesseldorf, added to sludge, was inactivated by mesophilic (35 C) and thermophilic (48 C) anaerobic digestion, but the viability of Ascaris suum ova was destroyed only by digestion at 49 C or by heating to 55 C for 15 min. When heat treatment (47-51 C) gave incomplete destruction of viability, subsequent mesophilic digestion reduced viability further. Salmonella spp. and cytopathic enteroviruses in thickened raw sludge were completely destroyed by pasteurization at 70 C for 30 min in the new full-scale sludge treatment plant at Colburn, Yorkshire, U.K., which used submerged combustion of gas from the following mesophilic digester as the sole source of heat. The data obtained during evaluation of this plant highlight the need for the control systems to be designed for intermittent operation to avoid incomplete treatment immediately after startup from cold. (Author's abstract)
W89-11116

SULFATE REDUCTION IN ACIDOGENIC PHASE ANAEROBIC DIGESTION.
Universidade Nova de Lisboa (Portugal). Faculdade de Ciencias e Tecnologia.
M. A. M. Reis, L. M. D. Goncalves, and M. J. T. Carrondo.
Water Science and Technology WSTED4, Vol. 20, No. 11/12, p 345-351, 1988. 3 fig, 2 tab, 20 ref.

Descriptors: *Biological wastewater treatment, *Anaerobic digestion, *Wastewater treatment, *Sulfates, *Stage treatment, Hydrogen ion concentration, Fluidized bed process, Fermentation.

The acidogenic phase of a two-stage anaerobic digestion process using distillery molasses slops effluent with high sulfate concentrations (4.2-5.1 g/l) was investigated. Removal of sulfate was studied at pH 5.8, 6.2, 6.6 and in two different reactors: continuous stirred tank reactor and an upflow fixed film fixed bed reactor. Batch experiments were carried out to obtain the maximum specific growth rates of sulfate reducing bacteria (SRB) at the above mentioned pH values. The biological sulfate removal increased with pH and so did the acetic acid production from the fermentative bacteria and SRB. For the same pH and hydraulic retention time, the sulfate reduction was more efficient in the fixed film reactor than in the CSTR. The soluble sulfides from the acidogenic reactor effluent were precipitated before the methanogenic phase to avoid biogas contamination and methanogenic bacteria inhibition; under such conditions, sulfide concentrations in the biogas thus produced were very low, and high methane volumeteric rates of production were achieved. (Author's abstract)
W89-11117

BEHAVIOR OF CHLORINATED ORGANICS DURING ACTIVATED SLUDGE TREATMENT AND ANAEROBIC DIGESTION,
Imperial Coll. of Science and Technology, London (England). Dept. of Civil Engineering.
P. W. W. Kirk, and J. N. Lester.
Water Science and Technology WSTED4, Vol. 20, No. 11/12, p 353-359, 1988. 5 tab, 32 ref.

Descriptors: *Activated sludge process, *Dieldrin, *Lindane, *DDE, *Chlorophenols, *Wastewater treatment, *Polychlorinated biphenyls, *Primary sludge, Pilot studies, Biodegradation, Biological wastewater treatment, Statistical analysis, Sludge.

An activated sludge pilot plant was operated at 4, 6 and 9 d sludge ages with influent settled sewage from a full scale treatment works to study the behavior of a range of chlorinated organic micropollutants during activated sludge treatment and during anaerobic digestion in batch systems, and to identify the principal removal mechanisms of these pollutants. Background levels in sewage and significant removal was seen for dieldrin, lindane (gamma-HCH), DDE, polychlorinated biphenyls (PCBs), and 2,4-dichlorophenol (2,4-DCPol) at all sludge ages. Dieldrin, gamma-HCH, DDE, PCBs, 2,4,5-trichlorophenol (2,4,5-TCPol), 2,4,6-trichlorophenol (2,4,6-TCPol) and 2,4-DCPol were found to associate with activated sludge solids. 2,4-DCPol and 4-chloro-2-methylphenol (4-C-2MPol) were found to be biologically degraded. Mixed primary sludge from the same sewage treatment works was incubated anaerobically with and without azide addition to prevent biological activity. It is concluded that rapid removal of gamma-HCH was due to chemical degradation, while biological activity was concluded to be the mechanism for the removals of 2,4,-D, 2,3,5-T, 2,4,6-TCPol and 2,3,4,6-tetrachlorophenol (2,3,4,6-TeCPol). Statistically significant increases were observed for 2,3,4,6-TeCPol in azide treated incubations and for 2,4,5-TCPol and 2,4-DCPol in both treated and untreated anaerobic sludges. (Author's abstract)
W89-11118

DEVELOPMENT OF MULTI-STAGE REVERSING-FLOW BIOREACTOR (MRB) FOR WASTEWATER TREATMENT.
Public Works Research Inst., Tsukuba (Japan). Water Quality Control Div.
M. Takahashi, and S. Kyosai.
Water Science and Technology WSTED4, Vol. 20, No. 11/12, p 361-367, 1988. 9 fig, 3 tab, 2 ref.

Descriptors: *Wastewater treatment, *Biological wastewater treatment, *Stage treatment, *Pilot plants, Sludge, Bacteria, Sulfates, Biodegradation, Aeration, Retention time, Substrates.

The Multi-stage Reversing-flow Bioreactor (MRB) that utilizes a new biological interaction for organic substrate removal in wastewater has been developed. MRB has several stages; one stage consists of a downflow aeration vessel (AV) and an upflow biological reaction vessel (BV). Successful accumulation of self-granulated sludge (SGS) can be achieved in the BV. The biological interaction between sulfate reducing bacteria and sulfide oxidizing bacteria (Beggiatoa) is considered to contribute to SGS formation. The SGS is 2-10 mm in diameter and can be maintained in the BV with upflow space velocity of 144 m/day. A pilot plant study was conducted to demonstrate the performance of the MRB. The influent was municipal primary effluent. The total hydraulic retention time was 4.5 h, including the final solid-liquid separation in the last BV. The effluent quality was as fine as that of the conventional activated sludge process. The MRB has several advantages over the conventional biological wastewater treatment such as lower energy requirement, less sludge production, and no necessity for a final settling tank. (Author's abstract)
W89-11119

REMOVAL OF CADMIUM (II) FROM DILUTE AQUEOUS SOLUTIONS BY FUNGAL ADSORBENT,
Delaware Univ., Newark. Dept. of Civil Engineering.
C. P. Huang, D. Westman, K. Quirk, and J. P. Huang.
Water Science and Technology WSTED4, Vol. 20, No. 11/12, p 369-376, 1988. 7 fig, 2 tab, 9 ref. USGS Grant 14-08-0001-G1292.

Descriptors: *Biological wastewater treatment, *Cadmium, *Heavy metals, *Fungi, *Water quality control, *Adsorption, Water treatment, Biological treatment, Hydrogen ion concentration, Biochemistry, Ions, Physicochemical properties, Lead, Zinc, Cobalt, Copper, Asperigillus, Candida, Activated carbon, Separation techniques.

The Cd(II) removal capacity of various fungal species, including Asperigillus oryzae, A. clavatus, and Candida utilis, and other adsorbents was compared using pH as the master variable. The competitive effect of H ions on Cd(II) adsorption and the effect of chemical treatment of fungal biomass on its Cd(II) removal capacity were also investigated. A modified Langmuir adsorption isotherm was used to describe the effect of pH on adsorption. Results showed that amounts of cadmium adsorption increase abruptly at a specific pH value to a maximum value, then remain relatively constant upon further increase in pH. In the concentration range studied, i.e. about 0.00001 M, surface adsorption is the mechanism responsible for the removal of cadmium from solutions. In the low pH region, proton ions compete with cadmium ions for surface sites. Fungal species type also plays some role in the extent of cadmium adsorption, though this mechanisms is not clear. Contrary to most adsorbents such as activated carbon and oxide, the cadmium (II) seems more removable than other heavy metal ions such as Cu(II), Pb(II), Zn(II), and Co(II) by fungal biomass. Physicochemical treatment of the fungal biomass did not increase the Cd(II) adsorption capacity. Chitin content of the fungal biomass appears to play a small role in metal selectivity. Most significantly, the metal removal capacity of fungal biomass is as good or better than other adsorbents such as oxide and some activated carbon. Cd(II)-laden fungal biomass can be regenerated with strong acid. In a total of 8 adsorption-desorption runs, the total amount of Cd(II) removed was 35 mg/g dried weight. This is compatible with other adsorbents, specifically, activated carbon, soil and oxide. (Friedmann-PTT)
W89-11120

MECHANISM OF VOLATILE FATTY ACID REMOVAL IN A FIXED BIOFILM METHANE FERMENTATION REACTOR.
Hokkaido Univ., Sapporo (Japan). Dept. of Environmental and Sanitary Engineering.
Y. Inoue, and K. Koyama.
Water Science and Technology WSTED4, Vol. 20, No. 11/12, p 377-383, 1988. 9 fig, 4 tab, 7 ref.

Descriptors: *Biofilms, *Fermentation, *Anaerobic digestion, *Fatty acids, *Wastewater treatment, *Culturing techniques, *Methane, Kinetics, Biochemistry, Organic compounds, Substrates, Volatility, Acetates, Propionates, Butyrates, Diffusion, Metabolism.

Based on the theory of methanogenic and acetogenic reaction of three volatile fatty acids (VFA) substrates, acetate, propionate and butyrate, the acceleration factors of acetate decomposition was investigated, and a kinetic equation for such reactions is proposed and evaluated based on the experimental data. To demonstrate the hydrogen effect, several batch experiments were carried out with a fixed biofilm methane fermentation reactor (FBMFR) using a sole substrate of acetate, propionate or butyrate or a substrate mixture (acetate-propionate, acetate-butyrate). While using each volatile fatty acid and the mixture, an experiment of continuous incubation was carried out to investigate biofilm biota and structure through a scanning electron microscope. Results showed that for acetate, decomposition in biofilm progresses as a 0-order reaction. Hydrogen partial pressure in gas phase increases in sole substrate. Acetate decomposition if accelerated when propionate or butyrate coexists. For propionate, the reaction also progresses as 0-order. Decomposition from n-butyrate to acetate progresses as a 0-order reaction as well. In constant decomposition of acetate, the concentration of H can remain constant. Methanogenesis from hydrogen follows a type of Michaelis-Menten kinetics. In the development of the basic kinetic equation, the batch process of substrate removal in the fixed biofilm reactor is a heterogeneous reaction and is expressed as (1) a diffusion process of substrates from bulk liquid to biofilm surface, (2) a diffusion process of substrates in biofilm, and (3) ingestion process of substrates to the cell and a catabolism process of the substrates in the cell as (1) and (2) occur simultaneously in biofilm. It was shown that the proposed equation may be correct when batch removal kinetics of substrates with the FBMFR were developed using a heterogeneous model and numerical analysis. (Friedmann-PTT)
W89-11121

INACTIVATION OF HEPATITIS A VIRUS AND MODEL VIRUSES IN WATER BY FREE CHLORINE AND MONOCHLORAMINE.
North Carolina Univ. at Chapel Hill. Dept. of Environmental Sciences and Engineering.
M. D. Sobsey, T. Fuji, and P. A. Shields.
Water Science and Technology WSTED4, Vol. 20, No. 11/12, p 385-391, 1988. 2 fig, 1 tab, 22 ref.

Descriptors: *Wastewater treatment, *Viruses, *Pathogens, *Disinfection, *Water treatment, *Chlorine, *Water quality control, Kinetics, Public health, Enteroviruses, Wastewater treatment.

The kinetics and extent of inactivation of hepatitis A virus (HAV) as well as three other viruses, coxackievirus B5 (CB5) and coliphages MS2 and phiX174, by 0.5 mg/l free chlorine, pH 6-10 and 10 mg/l monochloramine, pH 8, at 5 C in 0.01 M phosphate buffer were determined. HAV was relatively sensitive to 0.5 mg/l free chlorine but relatively resistant to 10 mg/l monochloramine. Compared to HAV, CB5 was quite resistant to inactivation by free chlorine but similar in resistance to inactivation by monochloramine. Inactivation of phiX174 by free chlorine was rapid at pH 6-9 and intermediate between that of HAV and CB5 at pH 10. PhiX174 was inactivated most rapidly of all viruses tested by 10 mg/l monochloramine. Inactivation of MS2 by free chlorine was somewhat more rapid than HAV at low pH but less rapid than HAV at high pH. MS2 inactivation by 10 mg/l monochloramine was slowest of all viruses tested. These results indicate that HAV is inactivated relatively rapidly by free chlorine but relatively slowly by monochloramine. Coliphage MS2 is a reasonable model to predict inactivation of HAV by free chlorine and inactivation of HAV and CB5 by monochloramine. It is a poor model for predicting free chlorine inactivation of CB5 and perhaps some other human enteric viruses. (Author's abstract)
W89-11122

FATE OF MICROORGANISMS IN A TERTIARY TREATMENT SYSTEM.
Montgomery (James M.) Consulting Engineers, Inc., Pasadena, CA. Montgomery Labs.
L. Y. C. Leong, J. E. Colbaugh, H. W. Stokes, and

C. J. Leong.
Water Science and Technology WSTED4, Vol. 20, No. 11/12, p 445-447, 1988. 2 fig, 3 tab, 8 ref.

Descriptors: *Wastewater treatment, *Disinfection, *Infiltration, *Tertiary wastewater treatment, *Microorganisms, Coagulation, Flocculation, Design standards, Wastewater renovation, Sedimentation, Bioindicators.

Optimum filtration and disinfection design criteria under full-scale conditions were determined for the Tapia Water Reclamation Facility that would meet the California Administrative Code (Title 22) primary contact and reclamation requirements. The Las Virgenes Municipal Water District provides wastewater collection and treatment from a 120 sq mile service area in western Los Angeles County while its joint venture partner, Triunfo County Sanitation District, provides collection services in eastern Ventura County. Both flows are treated at the Tapia Water Reclamation Facility and service a few industrial clients. The effluent is reclaimed for discharge to Malibu Creek, which was designed as a body-contact recreational area, and the discharge standards, based on this designation, for total coliforms do not exceed 2.2/100 ml and 23/100 ml in more than one sample within any 30-day period. Because the effluent is also reclaimed, the wastewater must also meet Title 22 requirements. These guidelines specify conventional tertiary treatment with coagulation, flocculation, sedimentation, filtration and disinfection. Sampling of effluent and analysis of overall plant performance chemical and physical data, included those for microbiological indicators, enteric viruses, disinfection, seven day moving median, and turbidity and particle size distribution. These data indicated that an average flow deep bed filtration rate of 4.1 gmp/sf with 11 mg/l of chlorine for 100 minutes produces a tertiary effluent that meets the Title 22 requirements for the Tapia discharge. Coliform, HPC, enteric viruses, and particle counts were good microbiological indicators of nitrified tertiary effluent water quality. (Friedmann-PTT)
W89-11133

STUDY OF THE FEASIBILITY OF USING ACTIVATED SLUDGE AS SEED MATERIAL FOR AN ANAEROBIC REACTOR,
Tsinghua Univ., Beijing (China). Dept. of Environmental Engineering.
J. Jicui, W. Weimin, and G. Xiasheng.
Water Science and Technology WSTED4, Vol. 20, No. 11/12, p 449-450, 1988.

Descriptors: *Activated sludge, *Sludge seeding, *Anaerobic digestion, *Activated sludge process, *Wastewater treatment, Comparison studies, Sludge digestion, Feasibility studies, Methane, Continuous flow, Flocculation, Substrates.

Both the batch test and continuous flow test were used to study the possibility of using activated sludge instead of digested sewage sludge as the seed material in the upflow anaerobic sludge blanket (UASB) reactor. The batch test involved a mixture of methyl-alcohol and sodium acetate used as the substrate with activated sludge as seed at about 35 C. After 62 h of digestion, methane was produced. This proved preliminarily that the activated sludge might be used as seed material. For the continuous flow test, a lab-UASB reactor of 29 l volume at about 34 C was studied with glucose as substrate and activated sludge as seed material. Methane production was 68 percent. During the first 20 days of the continuous flow test, the sludge was largely in floc-form and the settleability of the sludge was poor; granular sludge was predominant, with methanogenic activity in the sludge increasing with the formation of the granules The characteristics of granulation using the activated sludge as the seed were similar to those using the digested sludge. Thus, use of activated sludge as the seed material is technically feasible. (Friedmann-PTT)
W89-11134

INFLUENCE OF SULFATE ON METHANE FERMENTATION IN A DEFINED MEDIUM.
Shimizu Construction Co. Ltd., Tokyo (Japan). Inst. of Tech.
K. Minami, Y. Tanimoto, M. Tasaki, S. Ogawa, and K. Okamura.
Water Science and Technology WSTED4, Vol. 20, No. 11/12, p 451-453, 1988. 2 fig.

Descriptors: *Sulfates, *Fermentation, *Methane, *Wastewater treatment, *Sulfur bacteria, *Growth media, *Culturing techniques, Anaerobic conditions, Hydrogen ion concentration, Bacteria, Microenvironment, Sulfides, Biochemistry, Substrates, Comparison studies.

To test whether methanol can support the growth of dissimilar sulfate-reducing bacteria with the presence of sulfate, the influence of sulfate on methane fermentation was tested using continuous runs of a bio-reactor packed with pumice stone at 53 C. Five grams of sulfate were added to the medium. Results suggested that sulfate-reducing bacteria might be growing in the medium when the pH is controlled between 7.0 and 7.5, instead of the acidic pHs between 6.5 and 7.0. Five bio-reactors operated by feeding media containing different sulfate concentrations indicated that the methane fermentation was not actively inhibited with sulfate even at 10 g/l of medium. To examine the influence on the sulfate reduction at various pHs, five bio-reactors were operated at different pHs, and tests were run using a feeding medium containing 1 g/l of sulfate. When pHs were varied more than 7.0, the proportions of sulfate conversion to sulfide were markedly increased, and more than 1 g/l of sulfate would be reduced to sulfide. Finally, an in vitro co-culture experiment was conducting using Methanosarcina sp. DSM 2906 as a typical thermophilic methanogene, and Desulfotomaculum nigrificans DSM 574 as a thermophilic sulfate-reducing bacterium, to study the reason for sulfate being reduced to sulfide in a medium containing methanol and sulfate. Methanosarcina sp. grew well in medium while D. nigrificans did not. These findings indicate that the sulfate-reduction reaction by sulfate-reducing bacteria occurs even when methanol-rich wastewater is treated by methane fermentation technology. (Friedmann-PTT)
W89-11135

DISTRIBUTION, CHARACTERIZATION AND ACTIVITY OF MICROBIAL BIOMASS OF AN AEROBIC FIXED-BED REACTOR.
Compagnie Generale des Eaux, Paris (France). Centre de Recherche.
C. Giuliano, and J. C. Joret.
Water Science and Technology WSTED4, Vol. 20, No. 11/12, p 455-457, 1988. 5 fig, 6 ref.

Descriptors: *Aerobic bacteria, *Species composition, *Wastewater treatment, *Aerobic treatment, *Microorganisms, *Biological wastewater treatment, *Growth media, Pilot studies, Pseudomonas, Biofilters, Acinetobacter, Aeromonas, Flavobacterium, Biomass.

The microbial ecosystem, including distribution, characterization and activity of a natural fixed microbial biomass was studied during the 25-day colonization step. A pilot scale reactor was designed, composed of four serial filters simulating one single biofilter unit, fed with primary settled urban wastewaters at a temperature of about 18 C. Analytical techniques used during the colonization period of the reactor were carried out for amount of biomass, volatile suspended solids, chemical oxygen demand, acridine orange direct count, and dehydrogenase activity. The study showed that during the first five days of a run, microbial colonization of the filters was quite fast, corresponding to 2.5 times 10 to the 10th power bacteria/100 grains. Bacterial biomass accumulation seemed to stabilize after 20-25 d of the run. There was a decreasing gradient of fixed biomass from the first to the fourth column of the reactor. Most of the species isolated were Acinetobacter, Aeromonas, Flavobacterium, and Pseudomonas. From the fifth day of colonization, pollution removal efficiency of the reactor remained quite stable. (Friedmann-PTT)
W89-11136

PHYSICO-CHEMICAL PARAMETERS DETERMINING THE RELATIVE BIODEGRADABILITY OF PARA-SUBSTITUTED PHENOLS BY BACTERIA ISOLATED FROM ACTIVATED SLUDGE.
National Research Inst. for Pollution and Resources, Yatabe (Japan).
Y. Urushigawa, S. Masunaga, and Y. Yonezawa.
Water Science and Technology WSTED4, Vol. 20, No. 11/12, p 459-461, 1988.1 fig, 2 tab, 2 ref.

Descriptors: *Wastewater treatment, *Biodegradation, *Physicochemical properties, *Phenols, *Biological wastewater treatment, *Activated sludge process, Activated sludge, Bacteria, Bacterial analysis, Growth media, Sludge, Microbial degradation, Biodegradation.

The relationship between the relative biodegradability and the physico-chemcial parameters of mono-substituted phenols (ortho, meta, and para-derivatives) was studied using isolated strains that degrade phenols via the ortho or meta-ring-fission pathway. Biodegradation rate constants of phenol and 8 para-substituted phenols (methoxy, acetylamino, methyl, cyano, nitro, fluoro, chloro, bromo) were measured with two strains of bacteria and the physico-chemical parameters determining the relative biodegradability were examined by multiple regression analysis. One strain isolated from aniline acclimated activated sludge was a gram-positive non-spore forming rod; the other from phenol acclimated activated sludge was a gram-negative rod. Both strains degraded phenol. The concentrations of phenols were measured by gas chromatography as the acetyl derivatives. Biodegradation rate constants were calculated from the initial reduction rates approximated to the first order reaction. Results of these calculations showed that the biodegradability of mono-substituted phenols by two bacterial isolates was determined by electronic (field and induction effect), steric (effect of the bulkiness of the substituent), and hydrophobic related to the permeability of a molecule through a cell membrane parameters of the test compounds, of which the last was significant in the gram-positive strain. (Friedmann-PTT)
W89-11137

BIODEGRADATION OF SYNTHETIC ORGANIC CHEMICALS IN GAC BEDS.
Houston Univ., TX. Environmental Engineering Program.
G. E. Speitel, L. Chih-Jen, and M. H. Turakhia.
Water Science and Technology WSTED4, Vol. 20, No. 11/12, p 463-465, 1988. 2 fig.

Descriptors: *Wastewater treatment, *Activated carbon, *Adsorption, *Chlorinated hydrocarbons, *Biodegradation, *Biological wastewater treatment, Contact beds, Substrates, Microbial degradation, Microenvironment, Phenols, Wastewater treatment, Organic compounds, Chemical wastes, Sorption, Adsorbents, Gas chromatography, Bioregeneration, Diffusion, Trace levels, Aerobic conditions.

Several aspects of biodegradation of synthetic organic chemicals (SOC), including paranitrophenol (PNP), dichlorophenol (DCP), pentachlorophenol (PCP), and trichloroethylene (TCE) were examined in chemical systems at substrate concentration of 1 to 20 micrograms/L. The research mainly investigated the biodegradability of low concentrations of SOCs, particularly their ability to act as primary substrates, the extent of and controlling factors in the biodegradation of sorbed SOCs, and the influence of biodegradation on the adsorption of nonbiodegradable SOCs. Experiments were conducted in laboratory scale granular activated carbon (GAC) beds and were initiated with the GAC and liquid phases in equilibrium. Substrate was then fed to the columns at the equilibrium concentrations. The liquid phase concentration of the SOC was measured by gas chromatography. Significant biodegradation of sorbed PNP commenced after about 5 days of operation. Another experiment consisting of three columns was run with PCP and a mixture of DCP and PCP. Biodegradation of sorbed DCP and PCP was negligible over the 80 days of operation. This was in sharp contrast to results with PNP, in which 20 percent bioregeneration occurred over 40 days. The negli-

gible amount of bioregeneration supports the idea that the removal of DCP and PCP observed in the liquid phase resulted from biodegradation. DCP and PCP were more strongly sorbed on GAC than PNP. Diffusion out of the GAC may be slower. Trace concentrations in combination with the lower biodegradability of DCP and PCP may permit only a small amount of biodegradation. TCE is an example of an SOC that is adsorbable and nonbiodegradable (at least under normal aerobic conditions). (Friedmann-PTT)
W89-11138

INFLUENCE OF POPULATION DYNAMICS ON THE 'STEADY STATE' BIODEGRADATION OF 2-CHLOROPHENOL BY A MIXED MICROBIAL COMMUNITY,
Clemson Univ., SC. Dept. of Environmental Systems Engineering.
J. K. Mackey, and C. P. L. Grady.
Water Science and Technology WSTED4, Vol. 20, No. 11/12, p 477-479, 1988. 1 fig, 2 tab, 3 ref.

Descriptors: *Wastewater treatment, *Population dynamics, *Phenols, *Microbial degradation, Culturing techniques, Growth media, Bacteria, Bacterial analysis, Antibiotics, Biodegradation, Substrates, Biomass, Species composition, Biological wastewater treatment.

A study was conducted to examine the factors influencing variations in effluent substrate and biomass concentrations about mean values characterizing pseudo-steady-state, continuous heterogeneous culture reactors. A 10-L chemostat containing a heterogeneous microbial community of sewage origin was sampled over a 10-d period using a 3-hr interval. The chemostat was fed 65 mg/L of 2-chlorophenol (2-CP) and 160 mg/L of L-lysine. Prior to the sampling period, over 60 bacterial colonies were isolated using spread plates and the organisms were defined in terms of their susceptibility/resistance to 19 antiobiotics. From these, 16 organisms were enumerated at each sampling time using spread plates. Results showed that six populations were predominant in the community. F-tests on the community enumerations showed that the interactions among the bacterial populations and their substrates in this chemostat were complex. Bacterial population dynamics influenced the steady state concentration of 2-CP, which exhibited cyclic behavior. It is significant that this behavior occurred frequently near the steady-state growth rate. Seemingly random fluctuations in the numbers of the bacterial populations were found to be related to each other; thus, the apparent randomness within the bacterial community had some order to it. (Friedmann-PTT)
W89-11141

FLOC-LOAD AS IT RELATES TO ENZYMATIC TRANSFER OF SOLUBLE SUBSTRATE AND SLUDGE BULKING CONTROL.
Transfield, Inc., Irvine, CA.
M. C. Goronszy, and W. W. Eckenfelder.
Water Science and Technology WSTED4, Vol. 20, No. 11/12, p 481-484, 1988. 7 fig, 3 ref.

Descriptors: *Wastewater treatment, *Biological wastewater treatment, *Flocculation, *Activated sludge, *Enzymes, *Activated sludge process, *Bulking sludge, Sludge, Adenosine triphosphate, Substrates, Microbial degradation, Growth media.

Floc-load and enzymatic transfer of soluble substrate from a wastewater into microorganisms in an activated sludge floc are related. In the absence of other metabolic selectivity pressures, this rapid sequestering of available soluble organics is required for the avoidance of filamentous sludge bulking in various reactor configurations. The specific oxygen utilization rate response to floc-loading is a measure of the magnitude of the enzymatic transfer capacity of a biomass and can be used to determine its maximum sorptive capacity. During the transfer process, the biomass adenosine triphosphate (ATP) content undergoes a rapid depletion for 20-30 minutes before increasing again. Relevant parameters associated with soluble substrate removal and floc-forming selectivity mechanisms are reviewed, including time/rate relationships between floc-load and specific oxygen utilization rate (SOUR), floc former selectivity and cell yield, and colloidal and small particulate organics removal and relative growth of floc forming microorganisms. (Friedmann-PTT)
W89-11142

GROWTH OF FILAMENTOUS BACTERIA IN THE PRESENCE OF HEAVY METALS.
Pennsylvania State Univ., University Park. Program in Ecology.
K. L. Shuttleworth, and R. F. Unz.
Water Science and Technology WSTED4, Vol. 20, No. 11/12, p 485-487, 1988. 2 fig, 1 tab, 3 ref. NSF grant ECE-8417663.

Descriptors: *Growth media, *Heavy metals, *Activated sludge process, *Wastewater treatment, *Sewage bacteria, *Biological wastewater treatment, Copper, Zinc, Nickel, Bacteria, Inhibition, Zoogloea, Calcium, Toxicity, Growth chambers.

The effects of cooper, zinc, and nickel on the growth of filamentous bacteria in an activated sludge treatment plant were investigated. Bacteria used for the study included Thiothrix strain Al, Eikelboom type 021N strain B, Eikelboom type 1701 strain 269, and the floc-forming bacteria, Zoogloea ramigera strain 106. Experiments were completed in triplicate in Erlenmeyer flasks with daily monitoring of growth after metals were added to the media aseptically. Calcium requirements were also tested in separate experiments with these strains. Of the heavy metals evaluated, copper was found to be the most inhibitory to all of the test bacteria. A lag of 4 to 15 d beyond the normal lag was observed when Thiothrix Al was grown in the presence of 1 micromole of copper; growth appeared to be normal after the initial lag. Zinc completely inhibited growth at 50 micromoles, but caused no visible effect at 10 micromoles. In contrast, 10 micromoles of nickel caused the cells of Thiothrix Al to become swollen and distorted. Zinc apparently has a slight stimulatory effect on type 1701 strain 269 at concentrations of 5 and 10 micromoles; however, 100 micromoles zinc was inhibitory. In contrast, growth of strain 269 was inhibited by 10 micromoles nickel and no growth was observed until day 15 at 100 micromoles nickel. Overall, all strains grew best at the higher calcium concentrations tested; the most toxic heavy metal was copper and the least was zinc. (Friedmann-PTT)
W89-11143

FIXED BIOMASS ACTIVITY IN AEROBIC BIOLOGICAL REACTORS USED FOR WASTEWATER TREATMENT.
Centre des Sciences de l'Environment, Metz (France).
J. C. Block, N. Nouvion, J. M. Cahen, Y. Lesty, and G. M. Faup.
Water Science and Technology WSTED4, Vol. 20, No. 11/12, p 489-491, 1988. 1 tab, 3 ref. French Ministry of the Environment grant GRUTTEE-Environment N83-274.

Descriptors: *Wastewater treatment, *Biological wastewater treatment, *Aerobic treatment, *Biological treatment, *Filtration, Oxygen uptake, Microorganisms, Biomass, Enzymes, Clogging, Head loss.

Experimental runs were carried out on an upflow fixed-bed reactor to determine the activity of the filter washing water and that of biomass samples taken from the reactor. The 24-h process cycle was determined by following head losses used as an indicator of the clogging in the filter and of the biomass growth. Due to a protocol of dispersion of the biomass into the filter, two fractions defined as fixed and shared biomass were obtained. Samples biomass was analyzed for volatile matter, deydrogenase activity, and oxygen uptake rate. The specific dehydrogenase activities or the specific oxygen uptake rates of the dispersed biomass were found to be always greater than those of the fixed biomass. The aggregation of the biomass into the reactor prevents its fullest potential use. (Friedmann-PTT)
W89-11144

ACTINOMYCETE SCUM PROBLEMS IN AUSTRALIAN ACTIVATED SLUDGE PLANTS.
Queensland Univ., Brisbane (Australia). Dept. of Microbiology.
L. L. Blackall, A. E. Harbers, P. F. Greenfield, and A. C. Hayward.
Water Science and Technology WSTED4, Vol. 20, No. 11/12, p 493-495, 1988. 3 ref.

Descriptors: *Wastewater treatment, *Actinomyces, *Scum, *Activated sludge process, *Australia, Biomass, Substrates, Bacteria, Foaming, Microorganisms, Activated sludge.

The formation of extensive, biological foams or scums on the liquid surfaces of domestic activated sludge plants in Australia was investigated. A survey of the problem in Queensland and Australia was carried out; the dominant organisms in the foam were isolated and identified; their physiology was investigated and the intrinsic reasons for foam formation were explored in the laboratory. Foaming in activated sludge plants was found to be a significant problem in Australia. Greater than 90 percent of plants in Queensland have experienced biological foaming episodes, while in 38 percent of the plants, the problem was continuously present. Nocardia amarae and a newly described actinomycete, Nocardia pinensis, were dominant organisms isolated from the foam. Plants that contained N. pinensis in the scum were found to be operated at long sludge ages. Although technical problems were experienced with chemostat methodology when applied to N. amarae, a limited amount of information about their physiology was obtained. The cells of N. amarae were found to be hydrophobic and a surfactant(s) was produced in culture. These are properties that suggest an explanation for the mechanism of foam formation based on adsorptive bubble separation theory. (Author's abstract)
W89-11145

OCCURRENCE OF FILAMENTOUS BACTERIA IN ACTIVATED SLUDGE (BULKING SLUDGE), ISOLATION AND CHARACTERIZATION.
Technische Univ. Berlin (Germany, F.R.). Dept. of Hygiene.
M. Ziegler, M. Lange, P. Kampfer, D. Hoffmeister, and D. Welti.
Water Science and Technology WSTED4, Vol. 20, No. 11/12, p 497-499, 1988. 1 fig, 1 tab.

Descriptors: *Wastewater treatment, *Activated sludge, *Bulking sludge, *Fermentation, Culturing techniques, Growth media, Substrates, Bacteria, Bacterial physiology, Bacterial analysis, Thiothrix, Haliscomenobacter, Sphoerotilus.

Filamentous bacteria were isolated and morphologically and cytologically characterized through cluster analyses. Results of the analyses showed a good agreement between physiological and morphological properties of the groups of filamentous bacteria studied, including Thiothrix spp. 021N, Haliscomenobacter spp., and Sphoerotilus natans. Based on the results of shaken cultures, preliminary batch fermentations were carried out to determine the growth characteristics of filamentous bacteria. During periods of high fructose concentration, reserve granules (sudanophilic) were stored up. These granules disappeared when the fructose concentration decreased. It was found that for type 021N/Thiothrix spp. and Haliscomenobacter spp., calcium was necessary for growth, as is known for S. natans. The growth of 021N/Thiothrix spp. isolates was inhibited by peptone concentrations above 1.0 g/l. This inhibition did not appear with Bacto peptone. This could explain why filamentous bacteria do not grow in 'fat' media. (Friedmann-PTT)
W89-11146

UNIFIED THEORY FOR MICROBIAL GROWTH CONTROLLED BY MULTIPLE LIMITING SUBSTANCES,
Nanyang Technological Inst., Singapore. School of Civil and Structural Engineering.
C. Chung-Yuan.

Water Science and Technology WSTED4, Vol. 20, No. 11/12, p 513-515, 1988. 1 fig, 1 tab, 8 ref.

Descriptors: *Limnology, *Wastewater treatment, *Model studies, *Growth kinetics, *Microorganisms, *Limiting nutrients, *Limiting factors, Enzymes, Growth rates, Toxicity, Inhibition, Risk assessment.

In general, models dealing with multiple limiting substances have mainly been derived from three different categories of studies, multiple toxicity, multiple nutrient limitation and inhibition of enzyme catalysis. As different basic mechanisms were assumed by these models, a simple and unique theory that handles all these types of multiple-substance limited growth does not appear to exist. A unified theory, based on a probabilistic foundation for microbial growth is presented, which is controlled by multiple limiting substances (including both nutrient and toxicant). Most of the existing kinetic models in the aforementioned three areas can be generated using one theory. The relative growth rate is the actual specific growth rate and is related to the probability of response, considering limiting nutrient alone (or non-response for toxicant). The most important new feature of the theory is its capacity to generate numerous cases characterized by the interval $0 <$ degree of correlation between average existing nutrient concentration and average toxicant concentration < 1. This theory has broad application, e.g., wastewater treatment, eutrophication studies, and risk assessment. (Friedmann-PTT)
W89-11150

MICROBIOLOGY ASSOCIATED WITH THE BIOLOGICAL TREATMENT OF AIRCRAFT PAINT STRIPPING WASTEWATER.
Oklahoma Univ., Norman. Environmental and Ground Water Inst.
M. C. Arquiaga, and L. W. Canter.
Water Science and Technology WSTED4, Vol. 20, No. 11/12, p 525-527, 1988. 1 tab, 2 ref.

Descriptors: *Microbiological studies, *Wastewater treatment, *Microbial degradation, *Bacteria, *Biological treatment, *Chemical wastes, *Biological wastewater treatment, Activated sludge process, Aerobic treatment, Bioindicators, Pseudomonas, Substrates, Growth media, Microorganisms.

A study was conducted to improve the performance of biological treatment units in the treatment of wastewater consisting of methylene chloride, phenol, and such compounds as paraffins, cellulose derivatives, petroleum sulfonates and naphthalene, all prevalent in U.S. Navy aircraft paint stripping wastewater. The biological treatability of this wastewater was evaluated with engineering methods using aerobic suspended growth (activated sludge) and aerobic attached growth. The performance of both processes was tested using bench-scale, batch-flow and continuous-flow experiments. Most of the bacteria used for the study were gram negative rods and coccibacilli such as Pseudomonas, Acinetobacter, Paracoccus, Moraxella, and Klebsiella, and gram-positive bacteria such as Bacillus. The ability of the isolated organisms to tolerate and eventually biodegrade toxic pain stripping wastewater was evaluated by growing the organisms on media containing toxic wastes in the same concentration as in the waste from which they were collected. The study results indicate that the Navy paint stripping wastewater is able to support microbial communities as large as those found in the biological treatment of domestic sewage. Pseudomonas and Bacillus could be used as indicators of the performance of treatment systems for Navy paint stripping wastewater since they are suspect of playing an important role in initiating the biodegradation process. (Friedmann-PTT)
W89-11153

LONG-TERM STUDY OF OCCURRENCE, DISTRIBUTION AND REDUCTION OF CAMPYLOBACTER SP. IN THE SEWAGE SYSTEM AND WASTEWATER TREATMENT PLANT OF A BIG TOWN.
Kiel Univ. (Germany, F.R.). Abt. Hygiene, Sozialhygiene und Gesundheitswesen.
C. Holler.
Water Science and Technology WSTED4, Vol. 20, No. 11/12, p 529-531, 1988. 2 tab, 8 ref.

Descriptors: *Campylobacter, *Wastewater treatment, *Municipal wastewater, *Bacterial analysis, *Biological wastewater treatment, *Sewage bacteria, Water temperature, Temperature effects, Hydrogen ion concentration, Coliforms, Urban areas, Seasonal variation, Baltic Sea, Meat packing industry, Bacteria, Population dynamics.

A one-year study as undertaken to determine concentrations of Campylobacters in sewage, their reduction during wastewater treatment processes and seasonal variations or other influences on their presence. The samples were taken in three-weekly intervals at different points of the sewage system or wastewater treatment plant of a large town on the Baltic Sea. Water temperature, pH and number of fecal and total coliforms were determined in the samples as well as the number of campylobacter. Campylobacter concentration in the abattoir effluent ranged between 7,000 and 4,900,000 cfu/100 ml, with a median value of 240,000 cfu/100 ml. A mean of 1,350 organisms per 100 ml were found in the sewage system. The subsequent clarification process reduced organisms by 99.5 percent. Mean Campylobacter counts for crude sludge were 110 cfu/100 ml and 930 cfu/100 ml. Seasonal variations were little and water temperature, pH, concentrations of fecal or total coliforms had no influence on Campylobacter counts. This study demonstrated that sewage from urban areas can be heavily contaminated with Campylobacter sp., with highest counts found in the abattoir effluent. Wastewater treatment processes can reduce these counts considerably. (Friedmann-PTT)
W89-11154

BEHAVIOR OF FACULTATIVE PATHOGENIC BACTERIA IN WASTEWATER TREATMENT PROCESSES.
Kiel Univ. (Germany, F.R.). Abt. Hygiene, Sozialhygiene und Gesundheitswesen.
G. G. Gerhardt.
Water Science and Technology WSTED4, Vol. 20, No. 11/12, p 533-535, 1988. 2 tab, 4 ref.

Descriptors: *Wastewater facilities, *Animal wastes, *Food-processing wastes, *Wastewater treatment, *Bacterial analysis, *Pathogens, *Coliforms, *Streptococcus, Enteric bacteria, Biological wastewater treatment, Pollutant identification, Path of pollutants.

Two sewage treatment plants and a wastewater drain were investigated in one-year studies to determine the behavior of facultative pathogenic bacteria such as fecal streptococci (enterococci, EN) and fecal coliforms (FC) and total coliforms (TC). Membrane filtration, incubation on agar, colony counts and bacteria identification were carried out. Results showed that fecal coliforms were lowest in count among the bacteria, and the enterococci ranged between fecal and total coliforms for all steps of the processes. There was little variation in bacterial number between the treatment plants. FC/EN rations decreased continuously along the drain with increased distance from an animal slaughter house. It is concluded that an FC/EN ration below 1-2 is normal for human sewage water while high ratios result from the inflow of animal waste. (Friedmann-PTT)
W89-11155

VIRUS REMOVAL BY DRINKING WATER TREATMENT PROCESSES.
Institut Armand-Frappier, Laval (Quebec). Centre de Recherche en Virologie.
For primary bibliographic entry see Field 5F.
W89-11198

SYNTHESIS AND PROPERTIES OF POLYSULFONE MEMBRANES.
Wroclaw Technical Univ. (Poland). Inst. of Environment Protection Engineering.
K. Majewska-Nowak.
Desalination DSLNAH, Vol. 71, No. 2, p 83-95, February 1989. 11 fig, 3 tab, 2 ref.

Descriptors: *Membrane processes, *Limnology, *Wastewater treatment, *Polysulfone membranes, *Dye industry wastes, *Textile mill wastes, Decoloration, Water treatment, Dyes, Hydraulic permeability, Turbulent flow, Ultrafiltration.

Two types of polysulfone (PS) membrane modules were synthesized: PS and PS-poly(methyl methacrylate) (PMM). The transport and separation of PS membranes depend not only on the casting parameters, but also on the substrates involved. The membranes cast under suitably selected conditions have the ability to yield 95-100% elimination of organic dyes of a molecular weight >700. The tubular (bar) PS-PMM module is found to be best suited for treatment of dye-house effluents. The PS-PMM modules exhibit an excellent hydraulic permeability (above 1.0 cu m/sq m/d MPa), and an efficient separation of high molecular weight organic dyes (above 90%), provided that the conditions of fluid flow are turbulent in nature. Long-range experiments have substantiated the utility of PS-PMM modules as applied to the decolorization of textile wastewaters by ultrafiltration. The efficiency of total organic C removal (50-63%) achieved at a volume flux varying from 0.35-0.95 cu m/sq m/d is considered satisfactory. (Sand-PTT)
W89-11200

EFFECT OF FLOW CONDITIONS ON ULTRAFILTRATION EFFICIENCY OF DYE SOLUTIONS AND TEXTILE EFFLUENTS.
Wroclaw Technical Univ. (Poland). Inst. of Environment Protection Engineering.
K. Majewska-Nowak, T. Winnicki, and J. Wisniewski.
Desalination DSLNAH, Vol. 71, No. 2, p 127-135, February 1989. 9 fig, 3 tab, 10 ref.

Descriptors: *Limnology, *Membrane processes, *Wastewater treatment, *Textile mill wastes, *Ultrafiltration, Polysulfone membranes, Dyes, Dye industry wastes, Retention capacity.

An ultrafiltration system with a tubular membrane module was used in an experimental study on the efficiency of organic dye removal from aqueous solutions and actual textile effluents. The module consisted of a polysulfone membrane which had been cast on the surface of a porous poly(methyl methacrylate) bar. At an optimum velocity of feed flow (0.76 m/s), the retention coefficient for organic dyes of molecular weight >780 exceeds 97%. A 200-h ultrafiltration of the textile effluent yielded removal efficiencies of 75-85% and 50-60% for chemical oxygen demand and total organic carbon respectively. Volume flux varied from 0.8 to 1.0 cu m/sq m/d. (Author's abstract)
W89-11202

TREATMENT OF PETROCHEMICAL WASTEWATERS-THE STATE OF THE ART.
Vanderbilt Univ., Nashville, TN.
W. W. Eckenfelder.
Water Science and Technology WSTED4, Vol. 20, No. 10, p 1-12, 1988. 8 fig, 7 tab, 4 ref.

Descriptors: *Oil wastes, *Chemical wastewater, *Wastewater treatment, *Biological treatment, *Oxidation, *Activated carbon, Reviews, Sorption, Biodegradation, Activated sludge process, Toxicity, Filtration, Chemical reduction, Benzenes, Organic compounds.

Petrochemical wastewaters contain a wide range of organics. Depending on the production processes, the organic concentration may range from several hundred mg/l to several thousand mg/l. It is also characteristic of petrochemical wastewater that a significant part of the organic content is nonbiodegradable in conventional biological wastewater treatment processes. This phenomenon is now becoming significant in view of changing regulations for discharge of effluent to receiving waters. In the United States, with the exception of some water quality limiting cases, effluent limita-

tions relate to biological oxygen demand (BOD) and suspended solids. These requirements could readily be met with a conventional process sequence of equalization, neutralization, oil separation, and biological treatment. While both the degradable and the non-degradable organics may be toxic, only the biodegradable are removed through conventional biological treatment. Technologies discussed include source treatment, biological treatment (including sorption, stripping, and biodegradation), carbon adsorption, and chemical oxidation). (Doria-PTT)
W89-11218

WASTE WATER TREATMENT AT THE WACKER CHEMIE CHEMICAL-PETROCHEMICAL PLANT, BURGHAUSEN, F.R.G.
Bayerische Landesanstalt fuer Wasserforschung, Munich (Germany, F.R.).
L. J. Huber.
Water Science and Technology WSTED4, Vol. 20, No. 10, p 13-19, 1988. 2 fig, 2 tab, 2 ref.

Descriptors: *Wastewater treatment, *Wacker-Chemie Plant, *Chemical wastewater, Biological wastewater treatment, Inorganic compounds, Organic compounds, Wastewater composition, Biological oxygen demand, Chemical oxygen demand, Activated sludge, Aerated lagoons, Mercury, Heavy metals.

Wastewater treatment in larger chemical and petrochemical plants affords the application of all available technologies for pollution abatement. Elimination of conventional and priority pollutants down to low concentrations in the effluent is necessary in the F.G.R. for the protection of surface waters. Special care is directed at chlorinated hydrocarbons. The Wacker-Chemie plant at Burghausen, which produces especially chlorinated and organic silicon compounds, uses a great number of in-plant measures, pretreatment steps, and, finally, a two-stage biological purification to attain a high effluent quality. Important in-plant measures comprise the perchlorination of all significant chlorohydrocarbon residues and the conversion to tetrachloroethylene and the reclamation of hydrogen chloride in the production of vinylchloride. Wastewaters from the manufacture of chlorinated hydrocarbons are pretreated by stream stripping or adsorbtion to macromolecular resins. Final treatment is effected by purification in a high rate activated sludge plant followed by an aerated lagoon. (Author's abstract)
W89-11219

DISTURBANCES AND INHIBITION IN BIOLOGICAL TREATMENT OF WASTEWATER FROM AN INTEGRATED REFINERY.
Centre for Research in Environmental and Water Resources Engineering, Haifa (Israel).
N. Galil, M. Rebhun, and Y. Brayer.
Water Science and Technology WSTED4, Vol. 20, No. 10, p 21-29, 1988. 8 fig, 4 tab, 14 ref.

Descriptors: *Oil wastes, *Wastewater treatment, *Biological wastewater treatment, *Industrial wastes, *Inhibition, Pilot plants, Flocculation, Flotation, Planning, Suspended solids, Phenols, Hydrocarbons, Biological oxygen demand, Chemical oxygen demand, Wastewater disposal, Activated carbon, Activated sludge.

Biological treatment of wastewater from an integrated oil refinery, containing hazardous contaminants, was studied in an on site pilot plant. The wastewater is pretreated by gravity separation, flocculation, and dissolved air flotation. Biotreatment of such wastewater poses several problems which have to be considered in planning, design, and operation of the treatment system. The process rate is relatively slow, due to the inhibitory effects. The mixed liquor volatile suspended solids (MLVSS) could not be maintained at concentrations higher than 2000 mg/l. Sudden discharges of concentrated phenolic wastes disrupted the process first by impairing bioflocculation, followed by complete inhibition of the biological process. Further improvement in performance of the biological treatment is now being studied using powdered activated carbon (PAC) in the activated sludge process. The results up to now indicate that it improves the process, probably by reducing the inhibitory action of the phenols at the steady state influent concentrations. Powdered activated carbon combined in the activated sludge cannot be a solution for the sudden high volume discharges of concentrated phenols. This problem can be solved only through interception, storage, and regulated gradual discharge. (Doria-PTT)
W89-11220

IN-SITU ADAPTATION OF ACTIVATED SLUDGE BY SHOCK LOADING TO ENHANCE TREATMENT OF HIGH AMMONIA CONTENT PETROCHEMICAL WASTEWATER.
Shuaiba Area Authority, Safat (Kuwait).
E. A. Alkhatib, and L. T. Thiem.
Water and Science Technology WSTED4, Vol. 20, No. 10, p 31-44, 1988. 13 fig, 5 tab, 15 ref.

Descriptors: *Activated sludge, *Adaptation, *Ammonia, *Chemical wastewater, *Oil wastes, *Wastewater treatment, *Shock loads, Oxidation, Dissolved oxygen, Hydrogen ion concentration, Temperature, Pilot plants, Sulfides, Biological oxygen demand, Chemical oxygen demand, Nitrification.

A unique method was developed to reduce high levels of ammonia in petrochemical wastewater by using a modified activated sludge process including both carbonaceous and nitrogenous oxidation. A pilot plant designed to control and measure dissolved oxygen, pH, temperature, and sludge age was constructed for this study. Petrochemical wastewater which was augmented by additions of ammonia to produce concentrations up to 390 mg/L was used as the influent waste to the pilot plant. The activated sludge biomass was adapted to the influent within the reactor by using a step-function shock loading procedure. After adaptation, the pilot plant was operated in the zero sludge wasting mode which resulted in a low excess sludge production rate and the prevention of nitrifier washout. After the biomass became adapted to the influent conditions, high percentage removals of ammonia, chemical oxygen demand, biological oxygen demand, and sulfide were measured. (Author's abstract)
W89-11221

HOMOGENEOUS CATALYTIC OXIDATION OF AQUEOUS SULFUR(IV) BY TRANSITION METAL IONS, PART III: EFFECT OF IRON(III), COPPER(II) AND MANGANESE(II) AND SYNERGISTIC CATALYSIS.
Kuwait Univ., Safat. Dept. of Chemical Engineering.
M. Reda.
Water Science and Technology WSTED4, Vol. 20, No. 10, p 45-47, 1988. 2 fig, 6 ref.

Descriptors: *Acid rain, *Air pollution control, *Catalysts, *Oxidation, *Sulfur, *Iron, *Copper, *Manganese, Sulfur dioxide, Sulfites, Sulfuric acid, Cations.

Knowledge of the reactions of aqueous sulfur(IV) species is very important in understanding the process of sulfuric acid formation in the atmosphere and for flue gas desulfurization. Sulfur(IV) auto-oxidation by dissolved oxygen proceeds very slowly in pure water, but trace quantities of transition metal ions such as Fe(III), Mn(II), and Cu(II) are capable of enhancing the auto-oxidation rate. The general effects of Fe(III), Cu(II), and Mn(II) on the homogeneous catalytic auto-oxidation of aqueous sulfur(IV) were investigated. Copper ions appear to have only a slight effect on the amount of sulfate produced compared with double distilled water. Fe(III) and Mn(II) are effective catalysts for the auto-oxidation of aqueous sulfur(IV). There appears to be a synergistic effect between Fe(III) + Mn(II) and Fe(III) + Cu(II), and the oxidation rate is constant over a range of two orders of magnitude of transition metal ion concentration. There appears to be no synergistic effect between Mn(II) and Cu(II). (Doria-PTT)
W89-11222

ACTIVATED SLUDGE TREATMENT OF WASTEWATER FROM A NYLON 6 MANUFACTURING PLANT.
Unitika Ltd., Uji (Japan).
M. Kageyama, and K. Tomita.
Water Science and Technology WSTED4, Vol. 20, No. 10, p 49-55, 1988. 4 fig, 2 tab, 7 ref.

Descriptors: *Wastewater treatment, *Activated sludge, *Chemical wastewater, *Polymers, *Acclimatization, Industrial plants, Textiles, Bacteria, Bacillus, Achromobacter, Nylon, Biological oxygen demand, Growth, Isolation.

The activated sludge treatment of wastewater containing epsilon-caprolactam from a Nylon 6 manufacturing plant was investigated by basic studies and operation of a full-scale treatment plant. Activated sludges were obtained from several municipal and industrial wastewater sources, or were prepared by mixing epsilon-caprolactam-utilizing bacteria (Bacillus sp. and Achromobacter sp.) with a municipal activated sludge. However, bulking phenomena were soon observed in the acclimatization of ordinary activated sludges, even when started from a very low concentration of epsilon-caprolactam. On the other hand, the activated sludge synthesized from epsilon-caprolactam-utilizing bacteria showed better results as regards sludge volume index (SVI), biological oxygen demand (BOD) removal, and transparency of treated water. Wastewater from the Nylon 6 manufacturing plant, which contained epsilon-caprolactam, was treated by this synthesized activated sludge in a bench-scale apparatus consisting of a 4 cu m aeration basin and a 1.4 cu m sedimentation basin. The optimum BOD demand loading was estimated to be 0.35 to 0.40 kg BOD/kg MLSS/day for this wastewater. Production of excess activated sludge was 10% of the BOD loaded. A wastewater treatment facility constructed in 1974, based on this preliminary experiment, operates successfully, producing treated water with a BOD below 10 mg/l. (Author's abstract)
W89-11223

EFFECT OF PETROCHEMICAL ACTIVATED SLUDGE ON SOIL PROPERTIES.
Universidade Federal do Rio Grande do Sul, Porto Alegre (Brazil).
For primary bibliographic entry see Field 5E.
W89-11225

UNEXPECTED ODOUR PROBLEM IN THE BIOLOGICAL TREATMENT OF CHEMICAL WASTEWATER,
DSM Linburg B.V., Geleen (Netherlands).
F. Dijkstra, M. Plum, and A. Geerdes.
Water Science and Technology WSTED4, Vol. 20, No. 10, p 83-90, 1988. 2 fig, 6 tab, 4 ref.

Descriptors: *Odors, *Biological treatment, *Chemical wastewater, *Wastewater treatment, *Tellurium, The Netherlands, Nitrification, Nitrogen, Denitrification, Catalysts, Odor control, Biological oxygen demand, Chemical oxygen demand, Wastewater composition, Settling tanks.

DSM, a large chemical company in The Netherlands, operated a plant for the biological treatment of the wastewater of about 35 production plants (organic and inorganic chemicals). A special feature of this biotreatment plant is complete nitrification of Kjeldahl-nitrogen, in combination with denitrification. Experiences with this installation are reported. A serious odor problem has arisen due to the presence of traces of a tellurium-containing catalyst from one of the plants. An organic tellurium compound with a very low odor threshold is produced in the wastewater treatment plant, mainly under anoxic, denitrifying conditions. One of the three lanes of the wastewater treatment plant was modified and is now temporarily operating without a denitrification step. A separate sewer line was constructed to feed the wastewater of the tellurium-discharging plant separately to this modified lane. The other two lanes operate in the normal way and treat only wastewater without tellurium. (Doria-PTT)
W89-11227

ANALYSIS OF THE COPESUL WATER-OIL SEPARATION SYSTEM.
Companhia Petroquimica do Sul, Triunfo (Brazil).
A. A. Leitao, and C. M. P. Rangel.
Water Science and Technology WSTED4, Vol. 20, No. 10, p 91-100, 1988. 4 fig, 1 tab, 11 ref.

Descriptors: *COPESUL, *Separation techniques, *Oil wastes, *Wastewater treatment, Oily water, Standards, Maintenance, Corrosion.

The design and operation of the water-oil separation system at COPESUL (Companhia Petroquimica do Sul) are discussed, and possible changes to be implemented to keep the oil and grease content of the effluent within the limits acceptable for its admission to SITEL (the integrated system of liquid effluent treatment of the South Petrochemical Complex) are considered. Since the start of operation, the system chosen, which includes a pre-separator and tiltable plate interceptor (TPI) water-oil separator, has experienced problems. The effluent generated has frequently had an oil and grease content above the limit set for acceptance by SITEL. The situation was investigated, and it was found that the problem was due to the following: operational conditions were different to the design conditions; oil with a density higher than water was present; there were deficiencies in the maintenance and cleaning systems. Various options were studied to eliminate these problems, and priority was given to increasing the capacity of the seperation system, segregating the oil with a density higher than water at its source, and increasing the frequency of system maintenance. It was thought that these measures would result in an effluent oil and grease content less than 100 mg/L, and that the separation system would operate with greater flexibility. (Author's abstract)
W89-11228

USE OF TOXICITY TESTS FOR ASSESSING THE EFFLUENT OF THE SOUTH PETROCHEMICAL COMPLEX TREATMENT SYSTEM.
SITEL, Triunfo (Brazil).
For primary bibliographic entry see Field 5A.
W89-11230

ACTIVATED CARBON AS AN ADVANCED TREATMENT FOR PETROCHEMICAL WASTEWATERS.
Guarino (Carmen F.) Engineers Ltd., Philadelphia, PA.
C. F. Guarino, B. P. Da-Rin, A. Gazen, and E. P. Goettems.
Water Science and Technology WSTED4, Vol. 20, No. 10, p 115-130, 1988. 23 fig, 9 tab, 2 ref.

Descriptors: *Wastewater treatment, *Activated carbon, *Advanced wastewater treatment, *Chemical wastewater, Pilot plants, Chemical oxygen demand, Color, Organic compounds, Colloids, Carbon, Benzenes, Chromium, Nickel, Mercury, Zinc, Phenols, Heavy metals, Cyanide, Brazil.

Two pilot plants using powdered activated carbon (PAC) and granular activated carbon (GAC), respectively, were operated for a period of 15 weeks, fed with the effluent of a petrochemical wastewater treatment plant in Brazil. The study was made using all available Brazilian carbons at the time. Isotherm tests and other carbon properties were used to select the carbons for GAC and PAC plants. At all times, the GAC pilot plant using carbon GM produced a colorless effluent from the amber-colored influent. At the same time, the PAC system, with a carbon dosage of 100 mg/l, was not capable of removing the color. One sample of carbon was regenerated to study its performance after regeneration. Data suggest that the adsorptive properties of the virgin and regenerated carbon may differ by as much as 12%. Tests indicated that the GAC system is capable of reducing organic priority pollutants to below detectable limits. Metal concentrations in the GAC effluent were at or below the proposed effluent standards. It is concluded that granular activated carbon is a sound advanced treatment process for petrochemical wastes to reduce organic priority pollutants to below detectable limits, producing an effluent with less than 150 mg/L chemical oxygen demand. (Doria-PTT)
W89-11231

TREATMENT OF PETROLEUM REFINERY EFFLUENTS IN A FIXED-FILM REACTOR.
Kuwait Univ., Safat. Coll. of Engineering and Petroleum.
M. F. Hamoda, and A. A. Al-Haddad.
Water Science and Technology WSTED4, Vol. 20, No. 10, p 131-140, 1988. 6 fig, 2 tab, 10 ref. Kuwait Environmental Protection Council Grant EPC.002.

Descriptors: *Oil wastes, *Biofilms, *Industrial wastes, *Wastewater treatment, Biological wastewater treatment, Chemical treatment, Aeration, Organic loading, Chemical oxygen demand, Oxygen transfer, Alum, Sulfides, Ammonia, Oil.

A four-stage fixed-film reactor with 0.5 cu m/d capacity and surface area-to-volume ratio of 72 was developed in which stationary submerged biofilms are attached to ceramic tiles and kept under diffused aeration. Reactor operation with a synthetic toxic waste and a petroleum refinery effluent was satisfactory. Organic loading was found to be a better operational or design parameter. An organic loading of 42 g COD/sq m/d or less is recommended to ensure good quality effluent. The reactor coped with organic and hydraulic overloads because of the good oxygen transfer capacity and the considerable quantity of attached biomass attained in the reactor. The majority of COD removal occurred in the first stage which retained the greatest quantity of attached biomass. Staging of the reactor is effective in damping excessive loadings. Biological treatment of the refinery waste removed up to 80% of COD and produced a good quality effluent but polishing of reactor effluent using alum treatment improved effluent quality for potential reuse. (Author's abstract)
W89-11232

SITEL: A SUCCESSFUL PETROCHEMICAL WASTEWATER TREATMENT SYSTEM.
CORSAN-SITEL, Triunfo (Brazil).
E. M. P. Goettems, Z. Simon, M. L. Baldasso, and E. S. Ferreira.
Water Science and Technology WSTED4, Vol. 20, No. 10, p 141-162, 1988. 7 fig, 7 tab, 29 ref.

Descriptors: *Oil wastes, *SITEL, *Chemical wastewater, *Wastewater treatment, *Monitoring, *Activated sludge process, Tertiary wastewater treatment, Bioassay, Groundwater, Water quality, Land disposal, Wastewater disposal, Sodium, Chlorides, Sulfates, Dissolved solids, Cost-benefit analysis, Toxicity, Fish, Costs, Operating costs, Economic aspects, Brazil.

SITEL, Integrated Wastewater Treatment System of South Petrochemical Complex, has been processing liquid wastes from this industrial area since November 1982. The Complex consists of an olefine plant and some second-generation plants that produce mainly thermoplastic resins. In this paper, a comprehensive appraisal is presented of the operation of SITEL during the years 1985-1986. Data on the raw effluents produced by the individual contributors are presented, together with information on removal efficiencies of all parameters monitored throughout the different units and phases of treatment. A comparison between design characteristics and actual operational data of the system is also provided. Results of bioassays and ecological monitoring show that the tertiary treatment phase reduces sublethal effects that are not detected by conventional physicochemical analyses. Priority pollutants are reduced by secondary (activated sludge) treatment. Groundwater and surface water quality are not altered by the effluent except for parameters associated with dissolved ions that are mobile in soil. It is concluded that the plant has been operating successfully with a high benefit-cost relationship. (Author's abstract)
W89-11233

EVALUATION OF INDUSTRIAL COOLING SYSTEMS USING RECLAIMED MUNICIPAL WASTEWATER.
California State Water Resources Control Board, Sacramento.
T. Asano, R. Mujeriego, and J. D. Parker.
Water Science and Technology WSTED4, Vol. 20, No. 10, p 163-174, 1988. 3 fig, 1 tab, 5 ref.

Descriptors: *Cooling towers, *Municipal wastewater, *Water reuse, *Reclaimed water, Performance evaluation, Public policy, Costs, Cooling water, Lime, Clarification, Chemical treatment, Alum, Precipitation, Ion exchange.

Evaluation of industrial cooling systems using reclaimed municipal wastewater was made. For an industry, three major conditions which can dictate considerations of water reuse for industrial cooling systems are: (1) scarcity of freshwater supplies, (2) public policy which encourages wastewater reuse, and (3) lower costs than those incurred with freshwater supplies. Several external treatment alternatives are available for the recirculating, evaporative cooling tower operation using reclaimed municipal wastewater (lime clarification, alum precipitation, and/or ion exchange). Internal chemical treatment of cooling tower makeup water is a component common to both freshwater and reclaimed water supplies. In spite of the higher costs of industrial cooling systems using reclaimed municipal wastewater, several conditions encouraging adaptation of wastewater reuse systems for cooling were identified and discussed. (Author's abstract)
W89-11234

RECOVERY AND RECYCLING OF LIQUID EFFLUENT AT GNFC-A STEP TOWARDS ZERO EFFLUENT.
Gujarat Narmada Valley Fertilizers Co. Ltd., Broach (India).
For primary bibliographic entry see Field 5G.
W89-11235

EXPERIENCE OF 16 YEARS' OPERATION AND MAINTENANCE OF THE FUKASHIBA INDUSTRIAL WASTEWATER TREATMENT PLANT OF THE KASHIMA PETROCHEMICAL COMPLEX-I. OPERATION AND MAINTENANCE.
Kyoto Univ. (Japan). Dept. of Environmental and Sanitary Engineering.
Y. Okawa, S. Shinozuka, R. Ota, and S. Matsui.
Water Science and Technology WSTED4, Vol. 20, No. 10, p 193-200, 1988. 2 fig, 2 tab, 2 ref.

Descriptors: *Oil wastes, *Wastewater treatment, *Japan, *Wastewater facilities, *Industrial plants, *Maintenance, *Operating policies, Nitrification, Municipal wastewater, Chemical industry, Food processing industry, Oil industry, Electric power industry, Standards, Water quality standards, Activated sludge process, Dissolved oxygen, Retention time, Ammonia, Alkalinity, Chemical oxygen demand.

The Kashima petrochemical complex and the Fukashiba industrial wastewater treatment plant are described. The complex consists of 19 core factories (petroleum, petrochemicals, and thermal power generation) and 39 other factories (including organic chemicals, foods, metals, machinery, etc.). The total amount of industrial wastewater produced is 59,800 cu m/day. The treatment plant also accepts municipal wastewater from the surrounding area, totalling 1,100 cu m/day. A system for charging for the industrial wastewater has been introduced. The water quality standards for the industrial wastewater discharged to the sewerage system and the effluent of the treatment plant are described. The main treatment process is activated sludge with operational conditions of high dissolved oxygen and long solids retention time (SRT). These operational conditions solved the problems of high ammonia and refractory substances in the influent. Complete nitrification occurred under the low alkalinity conditions and the effluent chemical oxygen demand was low due to the long SRT. Successful operation and maintenance were achieved by good cooperation between the factories and the treatment plant. (See also W89-11238) (Author's abstract)
W89-11237

EXPERIENCE OF 16 YEARS' OPERATION AND MAINTENANCE OF THE FUKASHIBA INDUSTRIAL WASTEWATER TREATMENT PLANT OF THE KASHIMA PETROCHEMICAL COMPLEX-II. BIODEGRADABILITY OF 37 ORGANIC SUBSTANCES AND 28 PROCESS WASTEWATERS.

Kyoto Univ. (Japan). Dept. of Environmental and Sanitary Engineering.
S. Matsui, Y. Okawa, and R. Ota.

Water Science and Technology WSTED4, Vol. 20, No. 10, p 201-210, 1988. 4 fig, 5 tab, 3 ref.

Descriptors: *Japan, *Wastewater facilities, *Wastewater treatment, *Oil wastes, *Industrial plants, *Biodegradation, *Organic compounds, Process water, Activated sludge, Hydrocarbons, Respiration, Measuring instruments, Acclimatization, Carbon, Biological oxygen demand, Chemical oxygen demand.

Twenty-eight process wastewaters and 37 organic substances identified in the wastewater of the Kashima petrochemical complex were subjected to biodegradability tests. The tests consisted of the activated sludge degradability method and a supplementary test using the respiration meter method. Both tests utilized the activated sludge of the Fukashiba industrial wastewater treatment plant, which was acclimatized to the wastewater and organic substances. The 28 process wastewaters were classified into biodegradable, less biodegradable, and non-biodegradable according to the percentage TOC removal and the BOD5/TOC ratio of the wastewater. The 37 organic substances were also classified into biodegradable, less biodegradable, and non-biodegradable according to TOC and COD sub Mn removal. In general, chlorinated compounds, nitro-aromatics, and polymerized compounds were difficult to biodegrade. From the biodegradability tests of the factory wastewaters, it was found that the refractory COD sub Mn loads of these factories contributed to the load remaining in the effluent of the wastewater treatment plant. Various improvements were made to reduce the discharge of refractory substances from the factories. (See also W89-11237) (Author's abstract)
W89-11238

STIMULATED BIOSEPARATION OF OIL AND CUTTINGS.

Rogalandsforskning, Stavanger (Norway).
T. Bilstad.

Water Science and Technology WSTED4, Vol. 20, No. 10, p 243-254, 1988. 9 fig, 7 tab, 4 ref.

Descriptors: *Wastewater treatment, *Oil wastes, *Oil drilling, *Separation techniques, *Oil, *Biodegradation, Nitrogen, Phosphorus, Seawater, Aerobic digestion, Bacteria, Biological oxygen demand.

Findings are presented from a search for conditions favorable for bioseparation of oil on cuttings in a marine environment. Attention was focused on cuttings with diesel and mineral oils with particular emphasis on possible effects of nitrogen and phosphorus additions, i.e., stimulated bioseparation. Natural and stimulated biodegradation studies in batch reactors as well as degradation of oil on stationary cuttings in flow-through aquaria are described. Successful biological separation of oil and cuttings was accomplished by addition of nitrogen and phosphorus to seawater in completely mixed aerobic batch reactors at 10 and 20 C. Substantial biodegradation in flow-through aquaria, however, was not accomplished. Water based drilling fluids are non-toxic to marine organisms, and disposal of associated drilled cuttings may therefore be accomplished safely. Drilling with oil based fluids, however, produces cuttings that may be environmentally toxic. Also, the ultimate fate of oil bound to cuttings when disposed to the ocean is not known with certainty. (Doria-PTT)
W89-11243

USE OF CARBON DIOXIDE IN THE NEUTRALIZATION OF ALKALINE WATER,

Research and Development Center, Liquid Carbonic Brazil, Rua Belisario Pena, 325 Penha, Caixa Postal 46-40, CEP 21020, Rio de Janeiro, RJ, Brazil.
L. E. D. Simas, and A. A. Pessoa.

Water Science and Technology WSTED4, Vol. 20, No. 10, p 255-260, 1988. 2 fig, 1 tab, 6 ref.

Descriptors: *Carbon dioxide, *Alkaline water, *Neutralization, *Wastewater treatment, Industrial wastewater, Primary wastewater treatment, Secondary wastewater treatment, Acids, Chemical reactions, Hydrochloric acid, Safety, Costs, Economic aspects.

The use of carbon dioxide in the neutralization of alkaline industrial wastewaters was studied. The perfecting of this technique has made it possible to achieve performance efficiencies of 80% to 90%, rendering the use of carbon dioxide economically viable. Carbon dioxide in contact with water forms carbonic acid, which can react with the alkaline content of industrial effluents, leading to neutralization. This intrinsic characteristic of carbon dioxide enables safe treatment to be achieved through its mild and effective action. The wastewaters are treated without the undesirable drawbacks consequent on the use of sulfuric acid, hydrochloric acid, acetic acid, etc. In addition to the various technical advantages of using carbon dioxide, the process has proven, from an economic viewpoint, to be highly competitive. (Author's abstract)
W89-11244

MANAGING WATER QUALITY IN RELATION TO THE PETROCHEMICAL INDUSTRY.

Anglian Water Authority, Norwich (England). Norwich Sewage Div.

For primary bibliographic entry see Field 5G.
W89-11245

ISA SPA PRIOLO ASSOCIATED BIOLOGICAL PLANT FOR DOMESTIC AND PETROCHEMICAL WASTEWATERS IN PRIOLO (ITALY): EXPERIENCE AND RESULTS AFTER 5 YEARS' MANAGEMENT.

IAS Siracusa Water Industry S.p.A., Priolo (Italy).
G. Franceschi, and M. Nicolosi.

Water Science and Technology WSTED4, Vol. 20, No. 10, p 271-282, 1988. 5 fig, 6 tab, 8 ref.

Descriptors: *Wastewater treatment, *Italy, *Wastewater facilities, *Biological treatment, *Municipal wastewater, *Chemical wastewater, Water transport, Pipes, Waste storage, Outfall, Wastewater composition, Activated sludge, Costs, Pilot plants, Maintenance.

Priolo Associated Biological Plant, designed and constructed for the treatment of 4300 cu m/h of industrial and domestic wastewaters, occupies a site of about 40,000 sq m near Siracusa (Italy). The main users of the plant are big petrochemical factories. The wastewaters are transported to the plant via a glass fiber reinforced plastic (GRP) pipe 40 km long. This paper gives some data on the characteristics of the treated wastewater, tests performed, process efficiency, type of management, and running costs. The results of research conducted using a pilot plant are briefly discussed. From May 1987, this research has enabled the biological plant to treat about 14 tons per hour of untreated sulfuric soda effluent sent directly from a petrochemical plant. The constant research activities implemented by the management have given the users of the plant the opportunity of reducing their highly expensive pretreatments to a minimum. (Author's abstract)
W89-11246

APPROPRIATE TECHNOLOGY FOR WASTEWATER TREATMENT IN COASTAL TOURIST AREAS.

Norges Tekniske Hoegskole, Trondheim.
H. Odegaard.

Water Science and Technology WSTED4, Vol. 21, No. 1, p 1-17, 1989. 15 fig, 10 tab, 45 ref.

Descriptors: *Wastewater facilities, *Wastewater treatment, *Tourism, *Coastal waters, Lime, Seawater, Coagulation, Suspended solids, Water quality standards, Wastewater composition, Particulate matter, Disinfection, Economic aspects.

The appropriate wastewater treatment technology for coastal tourist areas (1) can meet the effluent quality requirement, typically being good suspended solids and E. coli removal, and moderately good BOD removal; (2) can deal with the extreme variations in flow and composition of the wastewater that one must expect from these areas, and (3) is relatively simple to operate and is economically acceptable. It is shown that since such a significant part of the contaminants in wastewater appear as, or is associated with particles, a good particle removal should be the first step of wastewater treatment. Such particle removal may be obtained by wastewater coagulation. Since hygienization of the wastewater is wanted when discharging it to coastal waters, lime is most suitable as coagulant, since the high coagulation pH (10.5-12) results in considerable disinfection. Especially appropriate in coastal areas is the use of the lime/seawater process where 2-5 vol-% of seawater is added to the treatment plant inlet, resulting in improved clarification, reduced lime consumption, reduced sludge volume production, and a chemically stabilized sludge. A low cost chemical treatment, very useful in tourist areas, may be obtained by the use of precipitation ponds where the precipitant is added ahead of a pond system. The lime/seawater process could well be implemented also in this system. (Miller-PTT)
W89-11347

APPROACH TO SEWAGE TREATMENT FOR THE COASTAL TOWNS OF THE ISLE OF THANET, ENGLAND,

Southern Water Authority, Worthing (England).
F. N. Midmer, and M. J. Brown.

Water Science and Technology WSTED4, Vol. 21, No. 1, p 19-35, 1989. 6 fig, 9 tab, 16 ref, append.

Descriptors: *Wastewater treatment, *England, *Coastal waters, *Wastewater outfall, Seawater, Feasibility studies, Regional planning, Wastewater facilities, Public relations, Economic aspects, Swimming, Outfall, Tourism.

The wastewater treatment feasibility study of the Isle of Thanet in South East England deals in particular with: (1) marine based and land based treatment and their economic comparison, (2) the resource benefits associated with effluent re-use, (3) the comparison of area and local solutions, and (4) the final selection of individual sea outfalls for Margate and Broadstairs and an inland treatment works for Ramsgate. Design and operational parameters for the sea outfalls at Margate and Broadstairs are presented and important features of construction experience briefly described. The actual capital cost of the various options were very similar but the cheapest in terms of net present value (NPV) was the option which provided separate outfall solutions for each town. This reflects the impact of transfer costs mitigating against area solutions and the conclusion that marine treatment is generally the cheaper solution for coastal towns. The area treatment options, both outfall and works, were more costly and would have the greatest impact on the Authority's capital program due to the need to complete the treatment facility and transfer system before any benefit would be available. The chosen strategy was separate outfalls at Margate and Broadstairs and an sewage treatment works at Ramsgate. Improvements at Ramsgate would be a costly part of any scheme and, although the works was marginally more costly, it was considered it would assist public acceptance of the whole scheme. The resource benefit of effluent re-use would halve the difference in NPV's. The promotion of separate schemes would result in early improvement in the bathing water conditions as the completion of each scheme would result in an immediate reduction in pollution and bacteriological conditions on the coastline. (Miller-PTT)
W89-11348

SYSTEM FOR ON SITE TREATMENT AND DISPOSAL OF WASTEWATERS FROM TOURIST RESORTS,

National Technical Univ., Athens (Greece). Dept. of Civil Engineering.

D. G. Christoulas, and A. D. Andreadakis.
Water Science and Technology WSTED4, Vol. 21, No. 1, p 37-45, 1989. 1 fig, 28 ref.

Descriptors: *Recreation facilities, *Wastewater treatment, *Wastewater disposal, *Tourism, Outfall, Absorption, Effluents, Package plants.

A system for on-site treatment and disposal of wastewaters from tourist resorts was evaluated and compared to conventional package plants in the basis of experimental results obtained from a laboratory scale simulation of the system and reported data. The system was found to produce an effluent comparable to package plant effluents with respect to BOD5 and suspended solids, but superior with respect to reliability and fecal coliforms. Disposal of the treated effluent to the soil through absorption trenches or to the seas through a short outfall are the most appropriate disposal methods, although reuse for irrigation after disinfection can also be practiced. The initial capital cost of the system is at most half the cost of the conventional package plants and the operation and maintenance expenditure neglible. The system is particularly suited to recreational facilities with seasonal operation. (Author's abstract)
W89-11349

CURRENT U.K. RESEARCH INTO THE DESIGN AND OPERATION OF LONG SEA OUTFALLS.

WRC Engineering, Swindon (England).
D. Procter.
Water Science and Technology WSTED4, Vol. 21, No. 1, p 47-54, 1989. 7 fig, 10 ref.

Descriptors: *Sanitary engineering, *Wastewater outfall, *Wastewater treatment, *Outfall, *United Kingdom, *Marine environment, Water quality, Monitoring, Hydraulic design, Wastewater dilution, Maintenance, Performance evaluation.

The UK Water Industry's comprehensive research program to ensure that its outfalls are designed and operated in such a way as to adequately protect the environment. Brief details are provided of the engineering content of the overall UK research program including work on hydraulic design, initial dilution, structural design and operation, maintenance and inspection. Development of hydraulic performance monitoring procedures and equipment are dealt with in detail and typical results from early fieldwork are described. The UK Water Industry is heavily dependent on marine treatment of sewage. In the past, too little attention has been paid to the operation and performing of UK outfalls resulting in a substantial number either becoming blocked, corroded or suffering from poor water quality. Consequently, regular performance monitoring is required if these expensive assets are to achieve their objectives throughout their design life. The monitoring of outfall hydraulic performance is practicable; survey procedures have been developed and prototype equipment has been successfully evaluated. (Miller-PTT)
W89-11350

WASTEWATER TREATMENT AND DISPOSAL IN THE CITY OF DUBROVNIK.

Split Univ. (Yugoslavia). Faculty of Civil Engineering Sciences.
J. Margeta, J. Pupovac, and B. Ivanec.
Water Science and Technology WSTED4, Vol. 21, No. 1, p 55-66, 1989. 7 fig, 1 tab, 8 ref.

Descriptors: *Water quality control, *Wastewater treatment, *Wastewater disposal, *Yugoslavia, *Tourism, Seawater, Design criteria, Wastewater facilities, Air entrainment, Data acquisition, Professional personnel, Sanitary engineering, Pipelines, Water pollution prevention, Outfall.

A solution is presented for the problem of disposal of wastewater in tourist areas. It is applied to the Yugoslav part of the Adriatic Sea. Problems faced with the treatment facility built in Dubrovnik are discussed. The main difficulties with these systems are due to the great fluctuations in the wastewater volume, daily as well as seasonal. It is very difficult to dimension wastewater disposal systems efficiently in conditions of such extreme flow variations and to achieve highly reliable functioning of the system together with simplicity of management and maintenance. The developed tourist areas have specific characteristics and they need a specific approach to these problems. Although protection of the sea is of primary importance in these areas, it often happens that insufficient financial resources and short-term interests result in poor treatment systems. The reconstruction of these systems is both expensive and difficult. Another problem is the lack of reliable data and the limited means available for data collection. The structures are frequently incorrectly dimensioned. A specific problem with these systems is the shortage of skilled personnel. There is lack of acceptable literature in the field of dimensioning of these structures. Although progress has been made in this direction, with more available literature, it should be noted that all areas of the problem have not been dealt with in the literature to the same level; this is particularly true regarding selection of reliable input data for the computation of pipeline stability and tensioning, and the problems of air entrapment in the system. (Miller-PTT)
W89-11351

PERFORMANCE AND OPERATION OF SMALL ACTIVATED SLUDGE PLANTS IN TOURIST AREAS.

Athens School of Hygiene (Greece).
N. Katsiris, and A. Kouzeli-Katsiri.
Water Science and Technology WSTED4, Vol. 21, No. 1, p 67-75, 1989. 5 fig, 3 tab.

Descriptors: *Wastewater facilities, *Wastewater treatment, *Activated sludge process, *Tourism, Diurnal distribution, Aeration, Sludge, Performance evaluation, Water quality control, Operating policies, Design criteria, Maintenance, Mixed liquor solids, Sludge volume index, Mechanical equipment, Greece.

Small scale activated sludge plants are used extensively in tourist areas for the treatment of wastewaters from hotels and other tourist establishments. A recent survey carried out in a big tourist island of Greece showed that the majority of small plants did not perform satisfactorily. The most important problems identified were associated with diurnal flow fluctuations, inadequate control of air supply and sludge return rates, accumulation of grease and fats in the plant and bad design. Another important problem appeared to be the lack of trained personnel for the operation and maintenance of the plant. These problems are discussed in detail and possible measures are presented. Experimental results from the monitoring of two small extended aeration plants confirmed the bad effect of sudden surges of flow on effluent quality. Moreover, it was found that the time required for the start-up of the plant was approximately six weeks. Small plants can be used successfully in tourist areas for the treatment of sewage provided that care is taken in the design stage to minimize problems caused by surges of flow, inadequate control of the air supply, and sludge recycle. The importance of correct maintenance schedules cannot be overstated. A daily maintenance routine should include cleaning of baffles and weirs, removal of fats and scum, checking of air flow and air lift pumps, measurement of mixed-liquor sludge solids (MLSS) and sludge volume index (SVI). Regular removal of surplus sludge, at monthly intervals, is essential for correct MLSS concentration. All mechanical equipment should be checked and maintained properly at least once every year. (Miller-PTT)
W89-11352

SEWAGE TREATMENT AND DISPOSAL PROBLEM IN CYPRUS IN THE ABSENCE OF SEWERAGE SYSTEMS: LIMASSOL CASE STUDY--EVALUATION OF COMPROMISE SOLUTIONS,

Ministry of the Interior, Limassol (Cyprus). Dept. of Town Planning and Housing.
E. Malikides.
Water Science and Technology WSTED4, Vol. 21, No. 1, p 77-86, 1989. 2 fig, 8 tab, 8 ref.

Descriptors: *Wastewater treatment, *Wastewater disposal, *Coastal waters, *Aeration, *Tourism, *Cyprus, Sewer systems, Wastewater facilities, Swimming.

Due to the lack of central sewage systems in coastal towns of Cyprus, temporary measures have been imposed to protect health and environment. As a result, sewage is treated in small biological plants serving individual residential units. Effectiveness of treatment methods employed were examined and the method of extended aeration has proven to be the most suitable for Cyprus conditions. Design standards have to be modified to take into account the specific conditions at Cyprus, especially that of temperature. Statistical results from 45 small treatment plants operating in the town of Limassol showed that the vast majority of the plants failed to meet either performance standards in terms of BOD5, suspended solids or bacteriological requirements in terms of fecal coliforms. It was identified that the main reason for this was the lack of proper maintenance. The bacteriological quality of bathing waters has not been affected by temporary measures, although many secondary problems have arisen from the operation of about 90 small treatment plants at Limassol town. The per capita cost of construction, operation and maintenance of this decentralized system has proven extremely high compared with that of centralized systems. Improvement of the situation, in the short term, includes reconsideration of temporary measures, modification of design standards relying on reliable and high efficiency treatment methods and rising of plants maintenance level. Radical solution of the problem is the construction of the central sewerage system. (Author's abstract)
W89-11353

COMPARISON OF CENTRALIZED VERSUS DECENTRALIZED WASTEWATER SYSTEMS FOR COASTAL TOURIST AREAS.

Soil and Water Ltd., Helsinki (Finland).
P. Vaananen, and E. Gavrielides.
Water Science and Technology WSTED4, Vol. 21, No. 1, p 87-92, 1989. 5 ref.

Descriptors: *Sewer systems, *Wastewater treatment, *Wastewater disposal, *Wastewater collection, *Coastal waters, *Tourism, Centralization, Economic aspects, Future planning, Wastewater facilities, Economic aspects, Sanitation, Cyprus, Public health, Community development.

The pros and cons of a centralized versus decentralized system for wastewater collection, treatment and disposal is discussed, taking into account technical and economic aspects. Good sanitation is the key element in avoiding health risks in tourist areas. A centralized sanitation system with an adequate sewage collection network, a sewage treatment plant and an effluent disposal facility is often more economic than a decentralized sanitation system. In Cyprus, tourism has expanded rapidly during the past ten years. Hotels were obliged to take care of sewage treatment and disposal by themselves. As a result, there are a great number of small sewage treatment plants in Cyprus, each serving one hotel or a group of hotels in one area. The fact is that this situation will be only temporary. The development pattern in all advanced societies has gone from a great number of small plants to fewer big treatment plants. This development has taken place elsewhere and will no doubt take place also in Cyprus, sooner or later. (Miller-PTT)
W89-11354

RECLAMATION OF MUNICIPAL WASTEWATER.

National Research Centre, Cairo (Egypt). Water Pollution Control Lab.
F. A. El-Gohary, S. I. Abo-Elela, and H. M. El-Kamah.
Water Science and Technology WSTED4, Vol. 21, No. 1, p 93-99, 1989. 4 fig, 1 tab, 6 ref.

Descriptors: *Wastewater renovation, *Water reuse, *Wastewater treatment, *Municipal wastewater, *Advanced wastewater treatment,

Chemical coagulation, Effluents, Reclamation, Nitrification, Toxicity.

The feasibility of applying direct advanced treatment to municipal wastewater was investigated. A two-stage scheme was implemented. the first stage was direct chemical coagulation of primary effluent using different coagulants to remove suspended solids and reduce the carbon to nitrogen ratio to a range suitable for nitrification. The second stage was biological sand-bed to oxidize ammonia to nitrate. The pilot plant was designed to treat 6 cu m/day. The results obtained showed that chemical coagulation using ferric chloride gave high quality effluent suitable for agricultural purposes. Nitrification of the chemically treated effluent using a sand-bed at an overflow rate of 1.358 cu m/sq m/d completely eliminated ammonia. Almost complete removal of suspended solids was achieved. Residual COD and BOD values were 45 mg/l and 15.5 mg/l, respectively. Fish biotoxicity was completely eliminated after the nitrification process. (Author's abstract)
W89-11355

SMALL SEWAGE TREATMENT PLANTS AND WASTEWATER REUSE IN CYPRUS.
A. Larcou, and I. Hadjivassilis.
Water Science and Technology WSTED4, Vol. 21, No. 1, p 101-108, 1989. 1 fig, 4 ref.

Descriptors: *Wastewater facilities, *Tourism, *Coastal waters, *Water reuse, *Cyprus, *Wastewater treatment, Tertiary wastewater treatment, Secondary wastewater treatment, Irrigation, Disinfection, Water pollution prevention, Legislation, Public health.

Due to the lack of central sewage systems, small wastewater treatment plants have been installed, mainly in coastal tourist areas of the island. The plants consist of a secondary and tertiary treatment by double filtration. The treated waster after the tertiary treatment is used for irrigation purposes. The installation of small sewage treatment plants and wastewater reuse for irrigation in Cyprus is surely a profitable investment. Tertiary treated and disinfected water can be used for irrigation in areas adjacent to wastewater treatment plants and offers additional benefits to landscape development while preventing simultaneous pollution of the environment. There is a need to draft and enforce appropriate legislation covering wastewater discharges, levels of treatment and quality of treated water so that reuse for irrigation can operate safely without health risks. (Miller-PTT)
W89-11356

SURVIVAL OF PATHOGENIC BACTERIA IN ELEVATED TEMPERATURE OXIDATION PONDS.
Technion - Israel Inst. of Tech., Haifa. Sherman Center for Research in Environmental and Water Resources Engineering.
A. Barzily, and Y. Kott.
Water Science and Technology WSTED4, Vol. 21, No. 1, p 109-114, 1989. 6 tab, 12 ref.

Descriptors: *Wastewater treatment, *Pathogenic bacteria, *Oxidation ponds, *Temperature effects, Raw wastewater, Bacteria, Pilot plants.

The die-off of pathogenic bacteria was followed in an elevated temperature experimental oxidation pond. Raw wastewater was pumped from a suburban main sewer to the Environmental Engineering Department's pilot plant installations and was introduced daily into two experimental oxidation ponds to give a detention time of 10-12 days. One pond was held at 42-45 C while the other served as a control at ambient temperatures. Salmonella typhimurium was introduced daily into the two ponds. In another set of experiments, the Salmonella were kept in dialysis bags placed in the ponds. The dialysis bags were filled with saline, control pond effluent, or raw wastewater. The results showed that it is very difficult to isolate the bacteria from pond effluent. The number of Salmonella bacteria in the dialysis bags in the elevated temperature pond decreased by a few orders of magnitude within days. The Salmonella in the control pond survived for longer. It is thought that the high temperature and adverse environmental conditions caused the rapid die-off of the bacteria in the elevated temperature. Taking into account the fact that the numbers of the various pathogenic bacteria in nature are much smaller than the numbers introduced into experimental ponds, it is thought that effluents from oxidation ponds operating at temperatures in the range 40-45 C will not contain any pathogenic bacteria. (Author's abstract)
W89-11357

TREATMENT OF WASTEWATER CONTAINING OIL.
Higher Inst. of Chemical Technology, Burgas (Bulgaria). Dept. of Water Technology.
V. Mavrov, I. Dobrevski, V. Peneva, S. Rashkov, and N. Stathopoulos.
Water Science and Technology WSTED4, Vol. 21, No. 1, p 137-139, 1989. 1 fig, 4 tab.

Descriptors: *Wastewater treatment, *Coagulation, *Adsorption, *Oil wastes, Effluents, Chemical oxygen demand, Activated carbon.

The possibilities for treatment of a wastewater containing 120-170 mg/l of oil, with a chemical oxygen demand of 190-312 mg O2/l and a pH of 7-7.6, were studied. A treatment process of consisting of coagulation and adsorption was investigated. The effectiveness of coagulation was examined using aluminum sulfate, ferric chloride, and aluminum chloride and three activated carbons were considered for the activation process. Carbons A and B were new types of activated carbon based in different pyrolyzed brown coals, and carbon C was a commercial activated carbon. It was established that the optimum results were achieved by coagulation with 140 mg/l aluminum chloride ($Al_2(OH)_5Cl$), which produced a treated effluent with an oil content of 11-12 mg/l, followed by adsorption using activated carbon A, which gave a treated effluent with an oil content below 2 mg/l. Carbon A could treat up to 2000 bed volumes of water before regeneration of the activated carbon was necessary. (Author's abstract)
W89-11361

BIOLOGICAL REGENERATION OF ACTIVATED CARBON.
Higher Inst. of Chemical Technology, Burgas (Bulgaria). Dept. of Water Technology.
I. Dobrevski, and L. Zvezdova.
Water Science and Technology WSTED4, Vol. 21, No. 1, p 141-143, 1989. 1 tab, 12 ref.

Descriptors: *Wastewater treatment, *Activated carbon, *Regeneration, Adsorption, Pore size, Bioregeneration, Activated sludge process, Enzymes, Molecular structure.

The competitive adsorption of organic compounds and carbon bioregeneration are apparently the most important phenomena with regard to enhanced activated sludge treatment of wastewaters. The results of investigations into the effect of activated carbon pore structure on the process of carbon regeneration is reported. The suitability of several different commercial activated carbons for biological regeneration was investigated. The pore volume, pore radii, and surface area of the carbons were determined by mercury intrusion and BET methods. The adsorption capacities of the carbons were measured in completely mixed batch reactor systems. Heterogeneous micro-organism cultures and crude cell extract were used for bioregeneration of the carbons. The comparative adsorption and bioregeneration studies showed that there was no correlation between the original adsorption capacity and the regenerated adsorption capacity of activated carbons under the range of conditions used. This is due to the pore structure characteristics of the carbons. The enzymes from the group of oxidoreductases active in this process have molecular diameters in the range of 7-19 nm and they may be identified as exo-enzymes in the surrounding medium. Being much smaller in size than the microbial cells, the exo-enzymes may diffuse into the pore spaces and cause substrate degradation. It has been found that the regenerated adsorption capacity depends on the volume of the pores with radii, r, of 5-50 nm (50-500 A). (Author's abstract)
W89-11362

SIMULTANEOUS ORGANIC CARBON REMOVAL-NITRIFICATION BY AN ACTIVATED SLUDGE PROCESS WITH CROSS-FLOW FILTRATION.
National Research Inst. for Pollution and Resources, Yatabe (Japan). Water Pollution Control Dept.
Y. Suwa, T. Yamagishi, Y. Urushigawa, and M. Hirai.
Journal of Fermentation and Bioengineering JFBIEX, Vol. 67, No. 2, p 119-125, 1989. 5 fig, 4 tab, 10 ref.

Descriptors: *Organic carbon, *Nitrification, *Activated sludge process, *Filtration, *Wastewater treatment, Separation techniques, Dissolved solids, Activated sludge, Denitrification.

Simultaneous organic carbon removal-nitrification was carried out by an activated sludge process with cross-flow filtration while retaining a higher concentration of activated sludge. Operating the unit at about 0.10 g BOD/g VSS/day made the sludge retention time very long and simultaneous carbon removal-nitrification was achieved quite well. Compared with conventional activated sludge processes, the present process made possible nearly twice the organic volumetric loading by increasing the sludge concentration five-fold. A nitrification rate of about 0.30 g TKN/liter/day was attained. More than 27% of the oxidized nitrogen in the reactor was denitrified at the same time in most cases. (Author's abstract)
W89-11399

ENHANCED NUTRIENT REMOVAL OF IMMOBILIZED ACTIVATED SLUDGE SYSTEM.
Korea Advanced Inst. of Science and Technology, Seoul (Republic of Korea). Dept. of Civil Engineering.
H. S. Shin, and H. S. Park.
Biotechnology Letters BILED3, Vol. 11, No. 4, p 293-298, April 1989. 5 fig, 13 ref.

Descriptors: *Activated sludge process, *Nutrient removal, *Nitrogen removal, *Phosphorus removal, *Wastewater treatment, Organic wastes, Biological wastewater treatment, Denitrification, Nitrification, Activated sludge.

An immobilized activated sludge system with porous polyurethane foam pads was operated in a time-sequenced anoxic/oxic batch mode for enhanced nutrient removal. The operation mode was determined for nitrification, denitrification and phosphorus removal in a single reactor. Synthetic wastewater prepared with glucose was fed to the reactor at the rate of 2.5 liters per cycle. Air was introduced to the bottom of the reactor at the rate of 3.5 liters/min during aeration period while only mixing was applied by a paddle at 60 rpm during the anoxic period. A microprocessor computer controlled the system operation. Activated sludge for seeding the reactor was obtained from a sewage treatment plant. For acclimation and immobilization, synthetic wastewater of 500 mg/liter COD was fed in increasing loading rates for 2 months. The biomass concentration was controlled by wasting 130 ml of mixed liquor suspended solids at the end of the aeration period. After acclimation, the influent COD concentrations were changed in the order of 500, 750, 250, and 1000 mg/l. Samples were analyzed for nitrogen (total, ammonia, nitrite and nitrate nitrogen), phosphorus, alkalinity, and mixed liquor solids by Standard Methods. Morphological characteristics of the immobilized system were examined by a scanning electron microscope (SEM). SEM photographs show the biomass was held in an attached and entrapped condition. Dominant microorganisms were cocci and rod shapes with a few filaments, being different from that of a rotating biological reactor with two stratified microflora; filament mat on surface and comma-shaped rods in subsurface. This new trouble-free system showed better nitrogen and phosphorus removal than conventional activated sludge systems. (Geiger-PTT)
W89-11410

EVALUATION OF HENRY'S CONSTANT FOR H2S IN WATER AND SEWAGE EFFLUENTS.
Kuwait Univ., Safat. Dept. of Chemical Engineering.
For primary bibliographic entry see Field 5A.
W89-11427

SURFACTANT ADSORPTION BY ACTIVATED SLUDGE (TENSID-ADSORPTION AN BELEBTSCHLAMM).
Bundesgesundheitsamt, Berlin (Germany, F.R.). Inst. fuer Wasser-, Boden- und Lufthygiene.
W. Janicke.
Zeitschrift fuer Wasser-und Abwasser Forschung ZWABAQ, Vol. 22, No. 2, p 57-64, April 1989. 14 fig, 2 tab, 90 ref. English summary.

Descriptors: *Wastewater treatment, *Surfactants, *Adsorption, *Activated sludge, Hydrogen ion concentration, Sodium chloride, Freundlich equation, Wastewater treatment, Mathematical studies, Water treatment, Separation techniques, Graphical analysis.

Results of bench-scale experiments on the adsorption of anionic, nonionic and cationic surfactants by activated sludge are displayed graphically and discussed. The dependence of adsorption from time, pH-value and ionic strength (NaCl-concentration) is dealt with specially. The results are evaluated by means of the Freundlich equation as well as by the function of the sludge concentration. (Author's abstract)
W89-11433

WASTEWATER TREATMENT: MAXIMUM FLEXIBILITY ON A COMMERCIAL SCALE.
Tennessee Eastman Co., Kingsport.
D. W. Johnson, D. A. Powell, and B. F. Severin.
Chemical Engineering Progress CEPRA8, Vol. 84, No. 12, p 66-70, December 1988. 6 fig, 1 ref.

Descriptors: *Wastewater treatment, *Wastewater facilities, *Activated sludge, *Tennessee, Design criteria, Neutralization, Grit removal, Equalization, Diversion, Nutrient supplementation, Rapid mix, Clarification, Aeration, Economic aspects.

A new $80 million industrial wastewater treatment plant constructed in Kingsport, Tennessee has been sized to treat average loadings of 25 million gal/d and 200,000 lbs/d of biochemical oxygen demand (BOD). The wastewater plant includes the following unit processes: neutralization, grit removal, equalization, diversion, nutrient supplementation, activated sludge, rapid mix/distribution, clarification, and postaeration. The equalization, diversion, and aeration systems are designed as interrelated operating systems. An economic evaluation that considered equipment costs, power requirements, process efficiency, and maintenance costs was performed for the plug flow process arrangement. Process efficiency parameters included literature and field-evaluated alpha values and standard oxygen transfers for the equipment. A major difference between this facility and most wastewater treatment plants is that the process piping (approximately 120,000 ft) is above ground to enable rapid leak detection. The start-up followed an aggressive schedule requiring greater than normal planning for a smooth transition from construction to start-up. The facility design provides the ability to promptly respond to future process needs or ever increasing environmental protection standards. (White-Reimer-PTT)
W89-11455

HIGH HOPES FOR CATTAILS.
Barge, Waggoner, Sumner, and Cannon, Nashville, TN.
B. Dawson.
Civil Engineering CEWRA9, Vol. 59, No. 5, p 48-50, May 1989.

Descriptors: *Wastewater treatment, *Biological wastewater treatment, *Wetlands, *Aquatic plants, Wastewater lagoons, Kentucky, Cattails, Mine wastes, Storm runoff, Farm wastes, Municipal wastes, Industrial wastes, Heavy metals, Cost analysis.

In theory, wetlands are the perfect 'wastewater plant' for small communities. In Benton, Kentucky about 1 mgd are cleaned in three different cells, one for cattails, bulrushes, and a mixture of plants. Suspended solids settle to the bottom, creating anaerobic conditions, while aerobic conditions are present around the roots and stalks. Suspended solids, BOD, and fecal coliform counts are all below discharge standards, and nitrogen and phosphorus are also being removed to acceptable standards. Typically, the wetlands consist of shallow, free surface basins with an impermeable liner. In some instances, only one type of plant is sufficient. Other times, combinations of emergent, submerged and floating species are used. The two major problems with man-made wetlands are the large land areas required and concerns about heavy metal accumulation. Wetlands are also being constructed to treat stormwater runoff, refining wastes, polluted rivers, agricultural wastes, and in some cases acid mine wastes. A major advantage of the wetlands system is the low cost when compared with conventional treatment. (White-Reimer-PTT)
W89-11457

BUYING TOMORROW'S WATER.
For primary bibliographic entry see Field 6C.
W89-11458

ANAEROBIC SLUDGE DIGESTION USING MESOPHILIC-THERMOPHILIC PHASE SEPARATION.
National Central Univ., Chung-Li (Taiwan). Dept. of Civil Engineering.
T. C. Chang, Y. C. Wu, C. F. Ouyang, and O. J. Hao.
Journal of Chemical Technology and Biotechnology JCTBDH, Vol. 45, No. 2, p 85-96, 1989. 2 fig, 6 tab, 23 ref.

Descriptors: *Biological wastewater treatment, *Wastewater treatment, *Sludge digestion, *Anaerobic digestion, *Separation techniques, Phase separation, Volatile acids, Volatile solids, Methane, Cost analysis.

Phase separation of sludge digestion was investigated using a suspended growth system for the acid phase and a fixed-film system for the methane phase. A thermophilic temperature of 50 C was used in the methane reactor, while a mesophilic temperature of 37 C was maintained in the acid reactor. During the acid-phase stage, the volatile acid concentration and the reduction of volatile solids averaged approximately 2200 mg/d/cu m as acetic acid and 13 % (w/v), respectively, under a hydraulic retention time of 2 days. These parameters were not significantly affected by the applied solids concentration. Reduction of the retention time in the acid reactor from 2 days to 1 day decreased the methane content (18% versus 28%) and the volatile solids destruction (8% versus 13%), but produced the same amount of volatile acids. The total gas production for 10 days overall retention time was slightly higher than that for conventional single-phase sludge digestion. The significant cost saving in reactor volume and enhanced methane production may offset the increased energy consumption required for maintaining a thermophilic temperature during the methane phase. (Author's abstract)
W89-11465

USE OF DIMENSIONLESS PARAMETERS IN DESIGN OF CASCADE-CONNECTED REACTORS.
Technical Univ. of Istanbul (Turkey). Dept. of Civil Engineering.
Y. Muslu.
Journal of Chemical Technology and Biotechnology JCTBDH, Vol. 45, No. 2, p 123-134, 1989. 3 fig, 2 tab, 14 ref.

Descriptors: *Wastewater facilities, *Operating policies, *Biological wastewater treatment, *Wastewater treatment, Residence times, Nomograms, Continuous flow reactors, Stirred tank reactors, Mathematical models.

General relationships applicable to a wide variety of bacterial mediated wastewater treatment processes have been developed using continuous-flow stirred-tank reactors arranged in series. Monod kinetics and mathematical models of reactors-in-series were used to represent the actual conditions resulting from varying degrees of axial dispersion and wastewater qualities. A numerical method was developed and effluent concentrations from an equivalent reactor series expressed based upon a plug-flow reactor with the same inlet and outlet conditions. Using the numerical results obtained, a nomogram has been derived that enables the required hydraulic and solids residence times for a reactor with a given dispersion number to be determined, when inlet and outlet conditions and the coefficients of Monod kinetics are known. (Author's abstract)
W89-11467

ANAEROBIC DIGESTION KINETICS OF WINE-DISTILLERIES WASTEWATERS.
Cadiz Univ. (Spain). Dept. of Chemical Engineering.
D. Sales, M. J. Valcarcel, L. I. Romero, and E. Martinez de la Ossa.
Journal of Chemical Technology and Biotechnology JCTBDH, Vol. 45, No. 2, p 147-162, 1989. 8 fig, 2 tab, 19 ref.

Descriptors: *Industrial wastewater, *Wastewater treatment, *Food-processing wastes, *Anaerobic digestion, Wine distilleries, Mathematical models, Methane, *Biological wastewater treatment, Depuration, Retention time, Kinetics.

The experimental results of anaerobic digestion of wine-distilleries wastewaters have been compared with those obtained from two theoretical kinetic models. The substrate utilization model closely describes the kinetics of anaerobic digestion of wine-vinasses, except for those retention times which make the system unsteady (3 days) and for those retention times at which the kinetic coefficient k' is not constant (greater than 8 days). The methane fermentation model gives very accurate kinetics of anaerobic depuration of wine-vinasses, except for retention times less than 3 days. The maximum specific growth rate of organisms is 0.35/day and is not dependent on the form in which substrate concentration is expressed. The methane volumes (at STP) produced per gram of substrate added to the digester are 0.24 d cu m CH4/g COD and 0.36 d cu m CH4/g DVS (dissolved volatile solids), both at optimum retention time (6 days). (Author's abstract)
W89-11468

SUITABILITY OF ION EXCHANGE RESINS FOR THE REMOVAL OF CADMIUM FROM WASTEWATERS. PART I: SELECTION OF RESINS.
Villanova Univ., PA. Dept. of Chemical Engineering.
V. L. Punzi, and P. J. Edwards.
Water Pollution Control Association of Pennsylvania Magazine, Vol. 22, No. 3, p 20-23, May-June 1989. 1 tab, 13 ref.

Descriptors: *Ion exchange, *Resins, *Cadmium, *Wastewater treatment, Heavy metals, Adsorbents, Activated carbon, Performance evaluation, Acidity, Alkalinity.

A series of investigations was undertaken to study the suitability of ion exchange resins to chemically adsorb cadmium (II) from industrial wastewaters. Based on adsorbent properties such as surface area, pore volume, number of active sites, overall capacity, and durability, four ion exchange resins were selected for further study (Rohm and Haas Amberlite resins IRC-718, IRC-84, IR-120PD, and 252), since they were deemed most likely to produce favorable results. The Nuchar SN activated carbon was selected because it produced the best results in a previous study. Cadmium (II) concentration is monitored as a function of time with all adsorption rate experiments and replications performed at pH values of 3, 5, and 7 for each of the five adsorbents included in this study. No actual wastewaters were used. In developing the synthetic wastewater used in this study, a number of cadmium salts were

considered. Cadmium chloride solutions were selected based on criteria of solubility, resistance to alkalinity, and safety. (Doria-PTT)
W89-11505

STUDY OF SEWAGE SLUDGE TREATMENT BY MEIOBENTHOS, NITOCRA SP. AND MACROBENTHOS, NEANTHES JAPONICA (IZUKA).
Tohoku Univ., Sendai (Japan). Biological Inst.
K. Kumagai, and Y. Kurihara.
Bulletin of the Marine Biology Station at Asamushi, Tohoku University, Vol. 18, No. 3, p 103-108, March 1989. 2 fig, 1 tab, 14 ref. Grant-in-Aid No. 63115019 for Special Project Research from the Ministry of Education, Science and Culture of Japan.

Descriptors: *Copepods, *Wastewater treatment, *Sludge digestion, *Biological wastewater treatment, *Biodegradation, *Tidal flats, Polychaetes, Sludge, Benthic fauna, Culture media, Estuarine environment, Particulate matter, Decomposing organic matter, Wastewater management, Japan.

A pilot plant with an artificial tidal flat simulating natural estuarine tidal flat conditions was constructed and operated as a habitat for the polychaete, Neanthes japonica (Izuka), and it was shown that the sludge extracted from a domestic sewage treatment plant, mainly bacteria and protozoa, serves as food for the polychaete. The role of a meiobenthic Harpacticoida, Nitocra sp., on removal of particulate organic matter in the artificial tidal flat was examined. Nitocra sp. was able to ingest a large quantity of sludge extracted from sewage waste and feces excreted from N. japonica that had been fed on sludge, and completed one life cycle within three weeks. On the other hand, N. japonica could not feed on Nitocra sp. at any stage during its life cycle. These results suggest that the coexistence of Nitocra sp. and N. japonica is suited for the removal of particulate organic matter in an artificial tidal flat. Thus an artificial tidal flat may be considered as a method for sludge treatment, thus helping to solve a serious problem in modern urban management. (Fish-PTT)
W89-11584

STUDY ON SUBSURFACE WASTEWATER DISPOSAL SYSTEM IN SMALL COMMUNITY,
National Fisheries Univ. of Pusan (Republic of Korea). Dept. of Environmental Science and Engineering.
B. H. Lee.
Bulletin of National Fisheries University of Pusan, Vol. 28, No. 2, p 39-46, December 1989. 7 fig, 4 tab, 8 ref. English summary.

Descriptors: *Wastewater treatment, *Wastewater disposal, *Septic tanks, Soil disposal fields, Subsurface filters, Nitrogen removal.

This study was conducted to compare conventional septic tanks with modified septic tanks and to evaluate the efficiencies of soil subsurface systems. The modified septic tank which consisted of septic tank and anaerobic filter (rice crust media) had best efficiencies for a preapplication process of a soil subsurface system. The soil column test showed that the soil depth required for 95% removal efficiencies of pollutants would be over 50 cm. A reinvestigation of nitrate nitrogen removal processes is necessary for groundwater quality management. (Author's abstract)
W89-11608

MEANS OF DETERMINING DEPTH AND VOLUME REQUIREMENTS FOR INDIRECT PHOTOLYSIS TREATMENT SYSTEMS,
Nevada Univ., Reno. Dept. of Civil Engineering.
R. J. Watts, V. D. Adams, and E. J. Middlebrooks.
Environmental Science and Technology ESTHAG, Vol. 23, No. 5, p 550-555, May 1989. 6 fig, 1 tab, 30 ref.

Descriptors: *Wastewater treatment, *Organic wastes, *Disinfection, *Photolysis, Reactors, Light intensity, Sensitizer absorbance, Batch tests, Solar radiation.

Indirect photolysis in reactors under solar radiation has been proposed for the pretreatment of organic industrial wastes and for wastewater effluent disinfection. An equation with terms for light intensity and sensitizer absorbance was used to calculate indirect photolysis rate constants as a function of wastewater depth as a basis for pilot system design. The equation was initialized by using batch, bench-scale tests in which the surface photolysis rate constant was determined. Calculation of an empirical efficiency factor and estimation of light intensity allowed the determination of a rate constant profile for the water column. The accuracy of the calculations was verified by using laboratory reactors. The first step in the design of a photolysis reactor was the calculation of mean photolysis rate constants for successive depth. For each depth, the mean rate constant was used in the plug flow design equation to calculate reactor volume and area. Reactor area declined exponentially as a function of depth. The beginning of the asymptotic region of the exponential curve was the optimum reactor depth and area. The sensitizer concentration that would result in optimum reactor design (minimum reactor area) would be a function of the waste components, the waste strength, and the sensitizer. (Author's abstract)
W89-11618

GASIFICATION AND PYROLYSIS OF SEWAGE SLUDGES (VERWERTUNG VON KLAERSCHLAMM).
VEBA Oel A.G., Gelsenkirchen (Germany, F.R.).
H. P. Wenning.
Chemie-Ingenieur-Technik CITEAH, Vol. 61, No. 4, p 227-281, April 1989. 6 fig, 5 tab. English summary.

Descriptors: *Wastewater treatment, *Sludge treatment, *Sludge disposal, *Primary sludge, Gasification, Pyrolysis, Sludge reduction, Hydrogen, Incineration, Comparison studies, Performance evaluation.

Gasification and pyrolysis of sewage sludge were examined as alternatives to sewage sludge combustion. For this purpose, experimental gasification and pyrolysis tests were performed with primary sewage sludge from Emschergenossenschaft. The main objective of these tests was the evaluation of the yields and qualities for products gained via sludge gasification or pyrolysis and an assessment of the environmentally relevant properties of the related residues. Both process alternatives enable the utilization of sewage sludge without any negative impact on the environment. Due to the total use of the organic components from the sewage sludge in combination with an almost complete utilization resulting from the valuable hydrogen produced, gasification is an attractive alternative compared to the burning of sewage sludge, both from an environmental and an economic point of view. In the case of sewage sludge pyrolysis a portion of the organic components, however, will remain in the pyrolysis residue. Therefore, pyrolysis allows only a minor reduction of the residual product. (Author's abstract)
W89-11638

UPTAKE OF MERCURY FROM AQUEOUS SOLUTION BY DUCKWEED: THE EFFECTS OF PH, COPPER AND HUMIC ACID.
Louisiana State Univ. System, Baton Rouge.
S. C. Mo, D. S. Choi, and J. W. Robinson.
Journal of Environmental Science and Health (A) JESEDU, Vol. 24A, No. 2, p 135-146, February 1989. 9 fig, 2 tab, 9 ref.

Descriptors: *Path of pollutants, *Water treatment, *Wastewater treatment, *Water pollution treatment, *Mercury, *Duckweed, *Aquatic plants, *Hydrogen ion concentration, *Copper, *Humic acids, Chemical uptake, Absorption, Lakes, Toxicity.

Laboratory studies were conducted to determine mercury uptake by duckweed under a variety of conditions. The results indicated that duckweed absorbed mercury in water (e.g. lakes) and that after three days it contained up to 2000 ppm of mercury by weight of duckweed. The removal of mercury by duckweed appeared to be the combination of two major processes. First, the mercury was rapidly removed by the initial mercury binding sites of duckweed. The second process was the transportation of the mercury from the initial binding site to the final target organ of duckweed. This was a slow process and was observed after the third day. Removal was effective at pH 4 and 5 even at low levels of mercury. The presence of copper ions and 1.0 mM of EDTA suppressed the mercury uptake significantly. In addition, 10 mg of humic acid in 400 mL solution suppressed the mercury uptake to some degree, probably by complexing the mercury. Duckweed was resistant to acute mercury toxicity. (White-Reimer-PTT)
W89-11640

MODELING HEALTH RISKS ASSOCIATED WITH WASTEWATER REUSE AS IRRIGANT.
Yarmouk Univ., Irbid (Jordan).
For primary bibliographic entry see Field 3C.
W89-11641

AUTOMATED DESIGN OF WASTEWATER PLANTS.
Municipality of Metropolitan Seattle-METRO, WA.
R. W. Samstag, A. J. Lester, and F. S. Thatcher.
Civil Engineering (ASCE) CEWRA9, Vol 59, No. 6, p 54-56, June 1989. 3 fig.

Descriptors: *Sanitary engineering, *Project planning, *Wastewater facilities, *Automation, Management planning, Computer programs, Design criteria, Design methods, Cost analysis, Digital computers, Seattle, Washington, Process control, Civil engineering, Data storage and retrieval.

Wastewater treatment plant design requires three major steps: (1) predesign, in which loads are set, alternatives are compared in terms of cost, and design criteria are established; (2) design development, in which detailed process and instrumentation drawings are created for each element in the process train, and equipment and piping are sized; and (3) final design, in which detailed civil, architectural, structural, mechanical, electrical, and control drawings and detailed project specifications are prepared. The Municipality of Metropolitan Seattle (Metro) has begun to develop a computerized data base management system to support the design process for wastewater plants. The following existing software packages for IBM-PC-compatible computers are employed: the spreadsheet program Lotus 1-2-3 for data manipulation, dBASE software for storing data, AutoCAD software for preparing drawings, and Microsoft Word for word processing. Software for linking among these packages is referred to as 'The Design Machine.' The initial use (and the inspiration for developing the system) was the need to do in-house design work as part of upgrading a 2.8-mgd plant at Richmond Beach from primary to secondary treatment. Ultimately the spreadsheet program was used on other projects. It can now be used to monitor consultants' performance, compare one form of treatment against another, and to produce progress reports. The intended use of the word processing software to produce report using standardized paragraphs to be inserted by the computer has not been feasible because of differences among projects. This partially automated wastewater plant design approach may not reduce the cost of designing, but it is likely to shift engineers' time usage away from data manipulation toward more creative activities, such as design investigations and modeling. Designs may not be less costly, but they should be better designs. (Rochester-PTT)
W89-11645

DYNAMICS OF FECAL COLIFORM AND CULTURABLE HETEROTROPH DENSITIES IN AN EUTROPHIC ECOSYSTEM: STABILITY OF MODELS AND EVOLUTION OF THESE BACTERIAL GROUPS.
Montpellier-2 Univ. (France). Lab. d'Hydrobiologie Marine.
For primary bibliographic entry see Field 2H.
W89-11663

ANAEROBIC DIGESTION KINETICS OF WINE-DISTILLERIES WASTEWATERS.
Cadiz Univ. (Spain). Dept. of Chemical Engineering.
D. Sales, M. J. Valcarcel, L. I. Romero, and E. Martinez de la Ossa.
Journal of Chemical and Technology Biotechnology JCTBDC, Vol. 45, No. 2, p 147-162, 1989. 8 fig, 2 tab, 19 ref.

Descriptors: *Food-processing wastes, *Biological wastewater treatment, *Wastewater treatment, *Retention time, *Anaerobic digestion, *Model studies, Substrates, Model testing, Chemical wastes, Liquid wastes, Fermentation, Anaerobic conditions, Methane.

Experimental results of anaerobic digestion of wine-distilleries wastewaters are compared with those obtained from two theoretical kinetic models: the substrate utilization model and the methane fermentation model. Both models accurately predicted the performance of this depurative process, except at retention times of < 3 d, because the system works under non-steady state conditions. The minimum retention time was found to be between 2.6 and 3.3 days, with an average value of 2.85 days; therefore, the maximum specific growth rate of microorganisms was calculated to be 0.35/d. The maximum specific growth rate of microorganisms was found to be independent of the form in which the substrate concentration is expressed. The same does not occur with the kinetic constant. The retention times, both experimental and theoretical, needed to obtain both maximum substrate utilization rate (mass/volume/time) and maximum volumetric methane production rate (volume/volume/time), were found to be the same (approximately 4 d). For depuration levels greater than 95 percent, the methane volumes (at STP) produced per gram of substrate added to the digester were 0.24 cu dm CH4/g chemical oxygen demand and 0.36 cu dm CH4/g dissolved volatile solids concentration (DVS), both at the optimum retention time of 6 days. (Friedmann-PTT)
W89-11672

STUDY OF CONTACTING SYSTEMS IN WATER AND WASTEWATER DISINFECTION BY OZONE: I. MECHANISM OF OZONE TRANSFER AND INACTIVATION RELATED TO THE CONTACTING METHOD SELECTION,
Tsinghua Univ., Beijing (China). Dept. of Environmental Engineering.
Q. Zhu, C. Liu, and Z. Xu.
Ozone: Science and Engineering OZSEDS, Vol. 11, No. 2, p 169-188, 1989. 11 fig, 20 ref.

Descriptors: *Ozonation, *Wastewater treatment, *Water treatment, *Contact beds, *Disinfection, Mass transfer, Effluents, Wastewater, Mathematical studies.

It is proposed that the study of ozone disinfection contacting systems be studied from the standpoint of the mechanism of the process. The mass transfer rate should be the main controlling factor affecting ozone disinfection efficiency (because it controls the disinfection process) and its function should be closely associated with the performance of the contactor selected. It appears that there is a quantitative relationship between the mass transfer coefficient and the inactivation effect. To establish functional relationships among the parameters of ozone mass transfer coefficient, utilization efficiency, effluent ozone residual concentration and disinfection effect, a static mixer with a very strong mass transfer capability was selected for comparison with a conventional bubble column. The experimental comparison showed that the process of zone disinfection is controlled by the ozone mass transfer rate, and there is a functional relationship between overall mass transfer coefficient and survival ratio. As the ozone residual concentration in the effluent increases, the mass transfer rate and the inactivation effect will also be higher. There is no quantitative relationship between mass transfer coefficients and inactivation effects, although these two parameters might be different at the same percent ozone utilization. The static mixer is shown to be suitable for ozone disinfection, although it requires a pressure drop of about 0.5 kg/sq cm to overcome resistance. (See also W89-11688) (Friedmann-PTT)
W89-11687

STUDY OF CONTACTING SYSTEMS IN WATER AND WASTEWATER DISINFECTION BY OZONE: I. MATHEMATICAL MODELS OF THE OZONE DISINFECTION PROCESS WITH A STATIC MIXER,
Tsinghua Univ., Beijing (China). Dept. of Environmental Engineering.
Q. Zhu, C. Liu, and Z. Xu.
Ozone: Science and Engineering OZSEDS, Vol. 11, No. 2, p 189-207, 1989. 15 fig, 5 ref.

Descriptors: *Wastewater treatment, *Ozonation, *Contact beds, *Water treatment, *Disinfection, *Mathematical models, Mathematical studies, Model testing, Statistical analysis, Mass transfer, Simulation analysis.

The ozone disinfection process involves reactions between different phases, with results depending not only on the mass transfer between phases, but also on the disinfection reaction kinetics. The mass transfer process should be defined by the transfer rate and disinfection by the reaction rate. Research on the mechanism of the ozone disinfection process with a static mixer was conducted, and mathematical models were established for ozone disinfection with operating parameters and device parameters. Using the nonlinear Marquardt and linear methods for estimation of the parameters to fit the observed data, four equations were obtained to represent mass transfer and inactivation processes with the static mixer. The essential input vectors for the simulation process using these equations included simple disturbance of the essential vectors, transfer equations and output response value of the static mixer. A statistical verification was conducted for these model equations, and the results were satisfactory. (See also W89-11687) (Friedmann-PTT)
W89-11688

AMMONIA, NITRITE AND NITRATE NITROGEN REMOVAL FROM POLLUTED SOURCE WATER WITH OZONATION AND BAC PROCESSES.
Harbin Architectural and Civil Engineering Inst. (China). Water Pollution Control Research Center.
For primary bibliographic entry see Field 5F.
W89-11690

SOME SILICA-BASED DOUBLE SALTS AS ION EXCHANGERS USEFUL IN THE TREATMENT OF INDUSTRIAL EFFLUENTS AND CONTROL OF POLLUTANTS.
Aligarh Muslim Univ. (India). Chemistry Section.
K. G. Varshney.
Ecotoxicology and Environmental Safety EESADV, Vol. 17, No. 2, p 167-171, April 1989. 2 tab, 10 ref.

Descriptors: *Wastewater treatment, *Ion exchange, *Silica, *Water pollution control, *Metals, *Industrial wastewater, Hydrogen ion concentration, Salts, Temperature, Radiation, Comparison studies.

A systematic comparative study was performed on the various double salts based on silica. The double salts were found to be more stable chemically and thermally than single salts of this type. The total Na(+) ion exchange capacity of the material was determined by the column process using 100-150 mesh sized particles. The eluent obtained, which contained the H(+) ions, was titrated against a standard NaOH solution to determine the total amount of H(+) ions released by the ion exchanger. The elution behavior of all the samples were similar in that they rapidly released the H(+) ions almost completely (95%) in the first 70 ml of the eluant (0.1 M NaCl) from a column of exchanger. The results indicate that these inorganic ion exchangers are especially selective for certain metal ions that are common in industrial effluents and are hazardous to health if present in a concentration higher than the permitted limit. By selecting a particular ion exchanger the undesired metal ion can be separated from the effluents. Since inorganic ion exchangers are stable at high temperatures and under strong radiation, they have the added advantage of being useful under such conditions. (Author's abstract)
W89-11730

METABOLIC REGULATION OF BETA-HYDROXYBUTYRATE DEHYDROGENASE IN ACINETOBACTER CALCOACETICUS VAR. LWOFFI.
Johannesburg City Health Dept. Labs. (South Africa).
L. H. Lotter, and I. A. Dubery.
Water SA WASADV, Vol. 15, No. 2, p 65-70, April 1989. 7 fig, 2 tab, 25 ref.

Descriptors: *Bacterial physiology, *Activated sludge process, *Enzymes, *Wastewater treatment, *Metabolism, *Phosphorus removal, Bacteria, Biological wastewater treatment, Beta-hydroxybutyrate dehydrogenase, Heterotrophic bacteria, Model studies.

It has been proposed that variations in nicotinamide adenine dinucleotide (NAD)H/NAD ratio controll the mechanism of biological phosphate removal through its control of the synthesis and degradation of poly-beta-hydroxybutyrate (PHB). In view of the apparent importance of regulating PHB metabolism in biological phosphate removal, an attempt was made to confirm the presence of this enzyme in Acinetobacter calcoaceticus var. lwoffi strains isolated from an activated sludge plant, and to investigate some aspects of its metabolic control. Comparison of cell-free extracts of Acinetobacter isolates that accumulated PHB with isolates that did not revealed the presence of beta-hydroxybutyrate dehydrogenase only in PHB-accumulating isolates. One of these enzymes had a specific requirement for NAD and was inhibited by high substrate concentrations as well as NADH, acetyl-CoA, and oxaloacetic acid. The present findings provide direct support for the biochemical model of Wentzel and colleagues, which postulated metabolic feedback control as the regulatory mechanism that provided Acinetobacter with a means to proliferate under alternating anaerobic/anoxic/aerobic conditions. (Rochester-PTT)
W89-11743

ENHANCED POLYPHOSPHATE ORGANISM CULTURES IN ACTIVATED SLUDGE SYSTEMS: PART II. EXPERIMENTAL BEHAVIOUR.
Cape Town Univ. (South Africa). Dept. of Civil Engineering.
M. C. Wentzel, G. A. Ekama, R. E. Loewenthal, P. L. Dold, and G. R. Marais.
Water SA WASADV, Vol. 15, No. 2, p 71-88, April 1989. 18 fig, 5 tab, 26 ref.

Descriptors: *Wastewater treatment, *Activated sludge process, *Biological wastewater treatment, *Phosphorus removal, *Microorganisms, Polyphosphate organisms, Bacteria, Bardenpho system, UCT system, Model studies, Aerobic digestion, Anoxic conditions, Anaerobic metabolism, Acetates, Biochemistry, Culturing techniques.

Previous research with enhanced cultures of polyphosphate (polyP) organisms developed in modified Bardenpho and UCT systems showed that the mixed liquor in these systems consisted of more than 90% Acinetobacter spp., a polyP organism. The present study used enhanced cultures: (1) to identify the compounds influenced by biological excess phosphorus removal, (2) to identify the processes that act on these compounds, and (3) to conceptualize a mechanistic model that qualitatively describes the kinetic and stoichiometric behavior of the processes and compounds. Batch tests were conducted to investigated five aspects: (1) aerobic digestion of the mixed liquor; (2) response with addition of acetate under anaerobic conditions; with either (3) aerobic; or (4) anoxic response thereafter; and (5) response with acetate addition under aerobic conditions. In addition cation release and uptake were studied in batch

tests. The conceptual model developed based on these results included processes that can be grouped in three broad categories: sequestration of acetate, growth, and endogenous mass loss. Qualitatively the behavior indicated by the model agrees with present understanding of the biochemistry of the biological excess P removal phenomenon. The results agreed with a previously published biochemical model and experimental observations. (See also W89-11745 and W88-08906) (Rochester-PTT)
W89-11744

ENHANCED POLYPHOSPHATE ORGANISM CULTURES IN ACTIVATED SLUDGE SYSTEMS: PART III. KINETIC MODEL.
Cape Town Univ. (South Africa). Dept. of Civil Engineering.
M. C. Wentzel, P. L. Dold, G. A. Ekama, and G. R. Marais.
Water SA WASADV, Vol. 15, No. 2, p 89-102, April 1989. 15 fig, 8 tab, 10 ref, append.

Descriptors: *Mathematical models, *Wastewater treatment, *Activated sludge process, *Biological wastewater treatment, *Phosphorus removal, Microorganisms, Kinetics, Stoichiometry, Polyphosphate organisms, Municipal wastes, Bacteria, Bardenpho system, UCT system, Aerobic conditions, Denitrification, Anoxic conditions, Anaerobic metabolism, Biochemistry.

Using a previously-developed mechanistic model as a basis, a mathematical model was developed that describes the kinetics and stoichiometry of biological excess phosphate removal phenomena. In the mathematical model, 12 compounds and 13 processes are identified as essential to describe the biological excess removal phenomena. The process rates and stoichiometry are formulated mathematically and displayed in matrix form for ready visualization and systematic computation. The kinetic and stoichiometric constants in the model were evaluated directly from experimental observations. Batch and steady-state verification experiments were conducted in the Bardenpho enhanced culture system and UCT enhanced culture system. The behavior predicted by the model conformed closely with experimental observation. The mathematical model deals only with the anaerobic and aerobic states; anoxic states are not dealt with because the experimental enhanced cultures developed only include minimal growth of polyphosphate organisms that use nitrate as an electron acceptor. This aspect requires further investigation because, in systems receiving municipal sludges, denitrification and P uptake occasionally have been observed at laboratory and full scale. Despite certain restrictions, the model constitutes a major step towards incorporating biological excess P removal into the general activated sludge model. (See also W88-08906 and W89-11744) (Rochester-PTT)
W89-11745

OZONATION FOR NON-FILAMENTOUS BULKING CONTROL IN AN ACTIVATED SLUDGE PLANT TREATING FUEL SYNTHESIS WASTE WATER.
Pretoria Univ. (South Africa). Dept. of Chemical Engineering.
J. van Leeuwen.
Water SA WASADV, Vol. 15, No. 2, p 127-132, April 1989. 5 fig, 12 ref.

Descriptors: *Activated sludge process, *Bulking sludge, *Ozonation, *Industrial wastewater, *Wastewater treatment, South Africa, Synthetic fuels, Water reuse, Pilot plants, Aeration, Recycling.

A zero-discharge mode of operation at the South Africa fuel synthesis plant necessitates the infinite recycling of treated industrial waste water. The treatment process incorporates activated sludge units in which non-filamentous bulking and carry-over of solids often occurs. The use of ozone for the control of this non-filamentous bulking was investigated on a 33 l/day pilot-scale plant. An ozone dosage of 1 g/kg mixed liquor suspended solids per day could reduce the diluted sludge volume index from an average of 125 to about 70 ml/g mainly by preventing zoogleal growths, the main contributor to filamentous bulking. The solids losses were reduced from 437 to 194 mg/l. Ozonation in the aeration component was more effective than in the sludge recycle. (Author's abstract)
W89-11748

STUDY OF THE POPULATION OF MICROORGANISMS IN A MUNICIPAL ACTIVATED SLUDGE TREATMENT PLANT (ESTUDIO DE LA POBLACION DE MICROOGANISMS EN UNA PLANTA DEPURADORA URBANA DE FANGOS ACTIVADOS),
Barcelona Univ. (Spain). Facultat de Biologia.
H. Salvado, E. Gonzalez-Palacios, and D. Pilar-Gracia.
Publicaciones del Departamento de Zoolog is Universidad de Barcelona Facultad de Biologia, Vol. 14, p 21-29, 1988. 7 fig, 1 tab, 10 ref.

Descriptors: *Biological wastewater treatment, *Activated sludge process, *Microorganisms, Physical properties, Chemical properties, Fauna, Population dynamics, Succession, Species composition, Species diversity, Protozoa, Metazoa.

The microorganism populations in a waste treatment plant were studied during a three-month period. The following physico-chemical factors were determined: (1) temperature, (2) pH, (3) biochemical oxygen demand, (4) Cl(-), (5) NO2(-), (6) NO3(-), SO4(--), (7) soluble inorganic phosphate, (8) alkalinity, (9) conductivity, and (10) total suspended solids. The fauna is represented by a small metazoa and several protozoa. Ciliated protozoa are represented by Uronema marinum, Litonotus lamella, Opercularia minima, Vorticella microstoma, Euplotes sp. and Aspidisca costata. A good depuration in the plant is observed when the values of peritrich ciliate are between 60-70%. It is concluded that diversity is a good indicator of the state of the good depuration in the sewage plant, as the diversity grows when the BOD diminishes and vice versa. (Miller-PTT)
W89-11817

WASTEWATER NUTRIENT REMOVAL BY CHLORELLA PYRENOIDOSA AND SCENEDESMUS SP.
Hong Kong Polytechnic, Kowloon. Dept. of Applied Biology and Chemical Technology.
N. F. Y. Tam, and Y. S. Wong.
Environmental Pollution ENPOEK, Vol. 58, No. 1, p 19-34, 1989. 5 fig, 2 tab, 25 ref.

Descriptors: *Nitrogen removal, *Secondary wastewater treatment, *Phosphorus removal, *Wastewater treatment, *Nutrient removal, *Activated sludge, *Algae, Coastal waters, Hong Kong, Chlorella, Scenedesmus, Chlorophyta, Biological wastewater treatment.

Two different species of photosynthetic microalgae, Chlorella pyrenoidosa and Scenedesmus sp., were grown in settled and activated sludge sewage filtrates at two different inoculum sizes, aimed to reduce nutrient load from wastewater. Higher growth rates were recorded in cultures with higher inoculum size, and algal cells usually grew better in settled sewage than in activated sewage. As algae started to grow and multiply, both nitrogen and phosphorous content in wastewater decreased significantly. The removal rate was rapid during the first week of growth, and more than 2/3 of wastewater N and P was reduced. After the initial period, the removal rate slowed down. At the end of the study, more than 80% of total P and inorganic N present in settled sewage were reduced but such removal efficiency was lower in the activated sewage. In general, high inoculum size of algal cells provided more N and P removal than low inoculum, and Chlorella cells performed better than Scenedesmus. These results suggest that cultivation of Chlorella is one of the feasible methods to reduce the amount of nitrogen and phosphorous entering the coastal water near Hong Kong which, in turn, prevents the eutrophication problem. It is also clear that algal ponds with high inoculum size might be more suitable to be installed as a secondary rather than a tertiary treatment process. (Author's abstract)
W89-11824

ANALYSIS OF NITRIFICATION DURING THE AEROBIC DIGESTION OF SECONDARY SLUDGES,
Roorkee Univ. (India). Dept. of Civil Engineering.
D. S. Bhargava, and M. T. Datar.
Environmental Pollution ENPOEK, Vol. 58, No. 1, p 57-72, 1989. 4 fig, 2 tab, 21 ref.

Descriptors: *Activated sludge, *Biological wastewater treatment, *Wastewater treatment, *Secondary wastewater, *Aerobic digestion, *Nitrification, Hydrogen ion concentration, Temperature, Biodegradation.

The occurrence and progress of nitrification during aerobic digestion of activated sludge was studied under a wide range of initial concentrations of total solids (1000 to 80,000 mg/L), initial pH range of 4.5 to 10.4 and digestion temperature range of 5 to 60 C. Batch aerobic digestion studies on activated sludge grown on wastewater (enriched with organic solids from human excretal material) indicate that almost complete elimination of the biodegradable matter of the activated sludge was one of the essential prerequisites to initiate nitrification. Favorable ranges of temperature and pH for nitrification 25 to 30 C and 6.0 to 8.3, respectively. With all favorable conditions, a minimum period of about 2 days was necessary for population build-up of genera Nitrosomonas and Nitrobacter, and to initiate nitrification. Nitrate formation invariably lagged behind nitrite formation, but under certain conditions both phases of nitrification were observed to progress hand in hand. (Author's abstract)
W89-11825

WASTEWATER TREATMENT BY ION-EXCHANGE.
Commonwealth Scientific and Industrial Research Organization, Clayton (Australia). Div. of Chemical and Wood Technology.
B. A. Bolto, and L. Pawlowski.
E. and F. N. SPON, New York. 1987. 262 p.

Descriptors: *Wastewater treatment, *Ion exchange, *Chemical treatment, Industrial wastewater, Turbidity, Water reuse, Oxidation, Recycling, Water reuse.

The stringent requirements in force today for the treatment of wastewaters to make them fit for discharge have focused attention on improved methods of cleaning up effluents. At the same time, concern over the depletion of natural resources and rising costs of industrial raw materials has made recovery and recycling an increasingly cost-effective option in industrial waste management. This book is a detailed explanation of how ion-exchange technology can overcome these concerns by cleaning up industrial wastewater, while recovering their components for reuse. The first part of the book gives an up-to-date picture of ion-exchange technology, providing a framework for the discussion of the practical aspects of its application to wastewater treatment. The second part deals with the particular problems of industrial wastewaters, such as high turbidity and strong oxidizing properties. A series of flowsheets presents a clear guide to the diverse applications of ion-exchange technology in the recovery and reuse of water and chemicals from wastes, concentrating on methods in active use in industry or at the pilot-plant stage. (Lantz-PTT)
W89-11895

DESIGN SEMINAR HANDOUT: SLUDGE TREATMENT AND DISPOSAL.
Environmental Protection Agency Environmental Research Information Center Technology Transfer, 1977. 273p.

Descriptors: *Wastewater treatment, *Sludge digestion, *Sludge stabilization, *Sludge disposal, *Land disposal, Environmental effects, Incineration, Research priorities, Public health, Economic

aspects, Path of pollutants, Groundwater pollution, Population exposure, Risk assessment.

This seminar addressed sludge processing, conversion, and land application and the use of digester gas, solar energy, and sludge composting in wastewater treatment. The utilization/disposal options available for sludge include ocean dumping, incineration, and land disposal. Each has its own specific set of environmental problems. In order to implement any policy, a number of problems that presently inhibit sludge management must be resolved. These problems require research in the areas of both public health and wastewater treatment technology. The goal of processing and treatment research and development is to produce technology alternatives which can be used to prepare the sludge for application to the land or for one of the conversion processes so that the total cost of handling or disposal is minimized. Conversion processes have been divided between efforts devoted to upgrading conventional incineration and tasks oriented toward development of new processes. Objectives relating to land application management are to develop methods and technology to control the transformation and/or movement of pollutants through the soil, plants, groundwater, and human food chain. The difficulty in resolving the health effects issue is that data which will permit definitive evaluation and decisions regarding the significance of sludge in the human food chain do not exist to the satisfaction of the several scientific disciplines involved. (See W89-11909 thru W89-11915) (Lantz-PTT)
W89-11908

STABILIZATION AND DISINFECTION OF WASTEWATER TREATMENT PLANT SLUDGES.
Burgess and Niple Ltd., Columbus, OH.
R. F. Noland, and J. D. Edwards.
IN: Design Seminar Handout: Sludge Treatment and Disposal. Environmental Protection Agency Environmental Research Information Center Technology Transfer, 1977. p x-67, 18 exhibits, 26 ref.

Descriptors: *Sludge stabilization, *Wastewater treatment, *Disinfection, Lime, Economic aspects, Costs, Incineration, Sludge digesting, Anaerobic digestion, Chlorination, Aerobic digestion, Pathogens, Design criteria, Operating policies.

Sludge constitutes the most significant by-product of wastewater treatment; its treatment and disposal is perhaps the most complex problem which faces both the designer and operator of a waste-water-treatment facility. Raw sludge contains large quantities of microorganisms, mostly fecal in origin, many of which are pathogenic and potentially hazardous to humans. Sludge processing is further complicated by its variable properties and relatively low solids concentration. Solutions have long been sought for better stabilization and disposal methods which are reliable and economical and able to render sludge either inert or stable. The purpose of this report is to present a review of stabilization and disinfection method for municipal wastewater treatment plant sludges. Particular emphasis is on lime stabilization. Other unit processes which are discussed include: anaerobic and aerobic digestion, chlorination, heat treatment, flash drying, long-term lagooning, and irradiation. A case history of lime stabilization is presented which includes: capital and annual operation and maintenance costs; chemical, bacterial, and pathological properties; land application techniques; and design considerations. A comparison of the performance, capital and annual operation and maintenance costs for lime stabilization and anaerobic digestion have also been included. By 1985, at least 75% of all sludges produced will require stabilization by some method other than incineration. Most currently accepted sludge stabilization methods, e.g., lime stabilization, anaerobic, and aerobic digestion, have been shown to significantly reduce pathogen concentrations. Sludge does not need to be completely sterile prior to ultimate disposal but good sanitation practices are essential during both processing and ultimate disposal operations. (See also W89-11908) (Lantz-PTT)
W89-11909

REVIEW OF CONDITIONING, THICKENING AND DEWATERING OF SLUDGE.
J. R. Harrison.
IN: Design Seminar Handout: Sludge Treatment and Disposal. Environmental Protection Agency Environmental Research Information Center Technology Transfer, 1977. p 68-119, 3 fig, 17 tab, 14 ref.

Descriptors: *Sludge thickening, *Sludge drying, *Wastewater treatment, *Sludge conditioning, Dewatering, Sludge disposal, Primary wastewater treatment, Secondary wastewater treatment.

This report reviews the operating experience of the past 3-4 years in sludge conditioning, thickening, and dewatering, and recent applicable research and development activities in these same unit process areas. Innovative results achieved in operating plants are emphasized. The following categories of processes used in the treatment and disposal of sludges are expanded upon in this paper: thickening (blending), stabilization (reduction), conditioning (stabilization), dewatering, heat drying, reduction (stabilization), and final disposal. In classifying and describing sludge processing methods, the potential of a process to accomplish more than one task must be taken into account. Accordingly, this nomenclature attempts to recognize that four of the major categories (thickening, conditioning, dewatering, and reduction) have primary as well as secondary objectives. (See also W89-11908) (Lantz-PTT)
W89-11910

ANAEROBIC DIGESTER GAS, SOLAR ENERGY AND SLUDGE COMPOSTING IN MUNICIPAL WASTEWATER TREATMENT.
For primary bibliographic entry see Field 5E.
W89-11911

CHEMICAL FIXATION OF WASTES.
Municipal Environmental Research Lab., Cincinnati, OH.
For primary bibliographic entry see Field 5E.
W89-11912

REMOVAL OF PETROLEUM HYDROCARBONS AND MTBE FROM WATER BY A MULTI-STAGED POE AERATION SYSTEM.
Lowry Engineering, Inc., Unity, ME.
J. D. Lowry, and S. B. Lowry.
IN: Proceedings of the FOCUS Conference on Eastern Regional Ground Water Issues, September 27-29, 1988, Stamford, Connecticut. National Water Well Association, Dublin, Ohio, 1988. p 339-352, 9 fig, 1 tab, 10 ref.

Descriptors: *Water treatment, *Oil pollution, *Hydrocarbons, *Ethers, *Cleanup operations, *Aeration, Costs, Organic compounds, Water pollution treatment, Economic aspects, Granular activated carbon, Field tests, Domestic water, Adsorption, Water softening, Operating costs, Cost analysis, Iron, Methyl tertiary butyl ether.

Granular activated carbon (GAC) adsorption has long been the state of the art for point-of-entry (POE) treatment of private household water supplies that become contaminated with petroleum products such as gasoline and various fuel oils. However, the inability of GAC to effectively treat groundwater containing high levels of contamination and/or methyl tertiary butyl ether (MTBE) has created a need for an effective alternative in these POE applications. A new patented treatment system employing multi-staged diffused bubble aeration has been developed over the past four years. Twenty-two field prototypes are currently in routine operation in three states and in Canada. Improvements have been made over the period of study and a commercial version is being readied for introduction in the fall of 1988. The field performance for the 22 six-staged aeration system prototypes has been excellent. Levels of MTBE of 27,000 micrograms/L and gasoline concentrations of over 300,000 microg/L have been successfully treated to levels below 10 microg/L. The commercial version of the aeration system will consist of modules (18 in. X 32 in. footprint) used singly or in multiples to achieve desired performance for a given compound and its associated difficulty of stripping. The capital cost of a commercial aeration system will be approximately 50% higher than a typical 2-unit GAC installation with softening or other form of iron removal as pretreatment. When MTBE is present in significant concentrations, or petroleum contamination in high concentrations, GAC and aeration are not very comparable since GAC is incapable of economically removing the contamination. The operation cost of GAC, due to frequent bed replacement in these applications, makes aeration the only cost effective alternative. (See also W89-11916) (Lantz-PTT)
W89-11936

WATER POLLUTION CONTROL IN LOW DENSITY AREAS: PROCEEDINGS OF A RURAL ENVIRONMENTAL ENGINEERING CONFERENCE.
For primary bibliographic entry see Field 5G.
W89-11953

WATER AND LAND ORIENTED WASTEWATER TREATMENT SYSTEMS.
Corps of Engineers, New York. Special Studies Branch.
F. M. McGowan.
IN: Water Pollution Control in Low Density Areas: Proceedings of a Rural Environmental Engineering Conference. September 26-28, 1973, Warren, Vermont. University Press of New England, Hanover, New Hampshire, 1975. p 3-14, 3 tab.

Descriptors: *Wastewater treatment, *Wastewater disposal, *Water pollution control, *Land disposal, *Wastewater treatment, Nitrogen, Biochemical oxygen demand, Chemical oxygen demand, Ammonia, Organic compounds.

An overview of the land treatment technique for wastewater management and of advanced water-oriented techniques is presented. Technologies presented are capable of: (1) advanced water-oriented treatment processes able to remove or convert specific constituents not normally removed with secondary treatment; (2) ammonia removal; (3) total nitrogen removal; (4) 98% phosphorus removal; (5) residual biochemical oxygen demand and suspended solids removed; and (6) chemical oxygen demand removal. Judgements of the best or most appropriate technique are left to the designer and planner. The paper has three sections: (1) some introductory comments on the philosophy of pollution abatement; (2) a description of technologies; and (3) some observations on opportunities for multiple use of land treatment systems. (See also W89-11953) (Lantz-PTT)
W89-11954

LAND TREATMENT OF WASTEWATERS FOR RURAL COMMUNITIES.
Cold Regions Research and Engineering Lab., Hanover, NH.
S. C. Reed, and T. Buzzell.
IN: Water Pollution Control in Low Density Areas: Proceedings of a Rural Environmental Engineering Conference, September 26-28, 1973, Warren, Vermont. University Press of New England, Hanover, New Hampshire, 1975. p 23-40, 3 fig, 1 tab, 13 ref.

Descriptors: *Land disposal, *Rural areas, *Wastewater treatment, Wastewater irrigation, Spray irrigation, Overland flow, Rapid infiltration, Costs, Economic aspects, Design standards.

Three basic concepts are available for the land treatment of wastewaters: rapid infiltration, spray irrigation, and overland flow. In the physical sense, they differ as to the volume and the pathway of the liquid applied. They are defined as follows: spray irrigation--the controlled spraying of liquid onto the land at a rate measured in inches of liquid/week with a flow path of infiltration and percolation within the boundaries of the receiving site; overland flow--the controlled discharge by spraying or other means of liquid onto the land at a rate

measured in inches/week with the flow path being downslope sheet flow; and rapid infiltration--the controlled discharge by spreading or other means of liquid onto the land at a rate measured in feet/week with the flow path being high-rate infiltration and percolation. Design criteria, land requirements, and costs for these concepts are discussed in detail. These concepts are proposed as renovative systems and not as convenience disposal or convenience irrigation, and their design, construction, and operational management retain wastewater renovation as the functional intent of all system components and optimization of renovation as the functional goal. (See also W89-11953) (Lantz-PTT)
W89-11956

SEPTIC TANKS AND THEIR EFFECTS ON THE ENVIRONMENT.
California Univ., Berkeley. Sanitary Engineering Research Lab.
P. H. McGauhey.
IN: Water Pollution Control in Low Density Areas: Proceedings of a Rural Environmental Engineering Conference, September 26-28, 1973, Warren, Vermont. University Press of New England, Hanover, New Hampshire, 1975. p 43-53, 10 ref.

Descriptors: *Wastewater treatment, *Water pollution effects, *Septic tanks, *Environmental effects, Evapotranspiration, Dissolved solids, Seepage, Sand filters, Percolation, Cesspools.

At best, septic systems increase the total dissolved mineral content of local groundwaters and at worst may introduce bacteria, viruses, and degradable organic matter as well. From an environmental viewpoint the 'best' septic tank system is not the best of all possible alternatives in an urban situation. Rationally, it would seem undesirable to concentrate 2,000 to 15,000 septic systems on the roof of a single groundwater basin or along the margin of a recreational lake. Nor is it necessary today. On the other hand, the 'best' septic system is certainly adequate for the isolated dwelling, where service to man far exceeds any possible detriment to the environment. Assuming proper installation and successful operation of a septic system, the environmental effects are largely upon the quality of groundwaters. Effects with various types of percolation systems are: (1) cesspool--because the primitive system will work only on coarse or highly fissured material, raw sewage may move directly into groundwater supplies carrying tastes and odors from products of anaerobic decomposition of sewage solids, bacteria and viruses, undegraded detergents, partially degraded organic compounds, which will later degrade when water is withdrawn or outcrops on the surface, and nutrients capable of enriching surface waters; (2) narrow trench and seepage bed in biologically active zone--a properly operated aerobic soil system will remove from sewage effluents such factors as sewage bacteria and other particulate matter, viruses, phosphates, and synthetic detergents; (3) deep trench and seepage pit--these systems are installed in soils below the aerobic biologically active zone but above the maximum water table evaluation. They change the quality of tank effluent percolating downward by removal of bacteria, viruses, and suspended solids, and by immobilization of phosphates and ammonia on soil particles; (4) sand bed--effluent from the sand bed is discharged upon the surface, and in many cases, is of a better quality than the native surface water; and (5) evapotranspiration systems--the ET system can enhance the growth of vegetation and in this sense have a positive esthetic effect upon the environment. (See also W89-11953) (Lantz-PTT)
W89-11957

ANALYSIS OF SEPTIC TANK SURVIVAL DATA FROM 1952 TO 1972 IN FAIRFAX COUNTY VIRGINIA.
Fairfax County Health Dept., VA. Div. of Environmental Health.
For primary bibliographic entry see Field 5E.
W89-11960

USE OF SOIL FOR DISPOSAL AND TREATMENT OF SEPTIC TANK EFFLUENT.
Wisconsin Univ., Madison. Dept. of Soil Science.
J. Bouma.
IN: Water Pollution Control in Low Density Areas: Proceedings of a Rural Environmental Engineering Conference, September 26-28, 1973, Warren, Vermont. University Press of New England, Hanover, New Hampshire, 1975. p 89-94, 2 fig, 13 ref.

Descriptors: *Wastewater treatment, *Wastewater disposal, *Land disposal, *Soil treatment, Wisconsin, Septic tanks, Leaching, Mounds, Seepage.

According to state law, the soil must be used for disposal of septic tank effluent in Wisconsin. Many soils, however, do not accept or purify liquid effluent well. Among these are slowly permeable soil, thin permeable soil over very permeable creviced bedrock, and soil with periodic or permanent high groundwater. In addition, slope requirements have been defined, and construction in flood plains is not allowed. The general requirement for on-site waste disposal is the availability of at least 3 ft of sufficiently permeable unsaturated soil below the bottom of the seepage bed. An estimated 50% of the soils of Wisconsin do not meet this requirement and are thus unsuitable for on-site disposal. The general aim of on-site soil disposal of liquid wastes is to achieve adequate purification of effluent while maintaining adequate infiltration into and percolation through the soil. Purification of septic tank effluent or any other type of effluent must include removal of pathogenic bacteria and viruses, BOD, COD, and suspended solids. Significant reductions in N and P contents are necessary as well. The interdisciplinary Small Scale Waste Management Project at the University of Wisconsin is developing treatment and disposal systems that are an alternative to the conventional septic tank soil absorption system for all soils. A summary of current field investigations is presented. Dosing, the application of effluent once a day rather than as a continuous trickle, is the system of choice, achieved through: (1) dual-bed systems; (2) large, subsurface seepage beds; or (3) mound systems. A system is acceptable for on site treatment and disposal of liquid waste only if it is safe, economical, and reliable to construct and operate. Systems incorporating soil are usually attractive, because soil is very effective as a 'living filter' and normal maintenance costs are relatively low. (See also W89-11953) (Lantz-PTT)
W89-11961

COMPARISON OF SEPTIC TANK AND AEROBIC TREATMENT UNITS: THE IMPACT OF WASTEWATER VARIATIONS ON THESE SYSTEMS.
Colorado Univ., Boulder. Dept. of Civil and Environmental Engineering.
E. R. Bennett, K. D. Linstedt, and J. Felton.
IN: Water Pollution Control in Low Density Areas: Proceedings of a Rural Environmental Engineering Conference, September 26-28, 1973, Warren, Vermont. University Press of New England, Hanover, New Hampshire, 1975. p 95-108, 10 fig, 4 tab, 14 ref.

Descriptors: *Wastewater treatment, *Septic tanks, *Aerobic treatment, Comparison studies, Colorado, Water pollution sources, Water quality, Wastewater disposal, Flow profiles, Chlorination.

Nearly one third of the homes in the U.S. are located in unsewered areas and must rely on some form of individual treatment and disposal system for dealing with household wastewater. Currently, three types of home disposal systems are most commonly installed. These are: (1) the septic tank and leaching field; (2) septic tank and evapotranspiration bed; and (3) aerobic treatment units with surface discharge or discharge into leaching fields. Each of these types of systems incorporates special design and operational considerations into their successful application. Many septic systems and aerobic units have functioned poorly in Colorado. In some cases, they have caused dangerous pollution of wells and surface waters. In order to alleviate some of these problems, new technology is needed in individual home wastewater disposal systems as well as a better understanding and improvement of the present systems. Central sanitary water and sewer systems should be required in areas with dense population or soil conditions that are not well suited for leaching fields. Surface disposal of effluents from individual home systems should be avoided except when done under carefully controlled conditions. Significant flow lag and surges occur in home wastewater discharges. These factors have a significant negative impact on the operation of settling tanks, particularly the small secondary settling tank employed with some aerobic treatment units. Three-fourths of the pollution load from individual homes is contained in about one-third of the total effluent volume. This fraction also contains nearly all of the pathogens. Segregation of wastes with separate disposal of the toilet-garbage disposal fraction should be given more consideration. Aerobic treatment, chlorination, and surface irrigation may be very satisfactory for disposal of the shower, sink, and washing machine wastes. (See also W89-11953) (Lantz-PTT)
W89-11962

NITRATE CONTAMINATION OF THE WATER-TABLE AQUIFER BY SEPTIC TANK SYSTEMS IN THE COASTAL PLAIN OF DELAWARE.
Delaware Geological Survey, Newark.
For primary bibliographic entry see Field 5B.
W89-11964

ENGINEERING ECONOMICS OF RURAL WATER SUPPLY AND WASTEWATER SYSTEMS. PART I: ELEMENTS OF SYSTEM DESIGN.
Rice Univ., Houston, TX. Dept. of Geology.
For primary bibliographic entry see Field 6A.
W89-11966

ENGINEERING ECONOMICS OF RURAL WATER SUPPLY AND WASTEWATER SYSTEMS. PART II: APPLICATION OF ECONOMIC CRITERIA TO THE EVALUATION OF PROJECT FEASIBILITY (A CASE STUDY).
Rice Univ., Houston, TX. Dept. of Geology.
M. D. Campbell, and S. N. Goldstein.
IN: Water Pollution Control in Low Density Areas: Proceedings of a Rural Environmental Engineering Conference, September 26-28, 1973, Warren, Vermont. University Press of New England, Hanover, New Hampshire, 1975. p 159-180, 3 fig, 13 tab, 4 ref.

Descriptors: *Water supply, *Water treatment, *Management planning, *Wastewater treatment, *Economic aspects, *Rural areas, Costs, Public participation, Water treatment facilities, Wells, Maintenance.

The water supply system that is likely to be superior, both technically and economically, will be comprised of between three and five local 'cluster' systems each of which will have a well, treatment plant, one or more storage facilities, and distribution lines. A preliminary estimate of the first costs for the water system amounts to about $1,472 per connection. The recommended wastewater system will have a centralized collection system terminating at a single nominal 120,000 gallons per day (gpd) treatment plant that will discharge wastewater (receiving up to 97% biochemical oxygen demand (BOD) removal and chlorination) into the Guyandotte River, WV. A preliminary estimate of first cost/connection for the wastewater system is $3,006. This is only about 5% more than the national average cost (in 1973 dollars) for the systems that serve similarly sized communities. Inasmuch as the Big Creek Public Service District area presents a most difficult terrain for sewer construction, this should be a most cost-effective system. Major equipment failure, lack of management ability, and an inflated initial membership have been indicated as the three major causes of failure in rural water systems. Management includes the routine day-to-day operation of the system with systematic attention to the details of meter reading, bill collection, and maintenance. Major equipment failure after the initial warranty period can seriously threaten the continued oper-

ation of a system. Equipment repair and overhaul, which account for about 30% of total operation and maintenance costs, have been included in the operation and maintenance estimates for this project. (See also W89-11953) (Lantz-PTT)
W89-11967

IMPROVED FIELD TECHNIQUES FOR HYDRAULIC PROPERTIES OF SOILS.
Wisconsin Univ., Madison. Dept. of Soil Science.
For primary bibliographic entry see Field 7B.
W89-11968

EROSION-TYPE HYPOCHLORINATORS FOR THE DISINFECTION OF WATER SUPPLY AND WASTEWATER IN LOW DENSITY AREAS.
Yale Univ., New Haven, CT. School of Medicine.
E. W. Mood.
IN: Water Pollution Control in Low Density Areas: Proceedings of a Rural Environmental Engineering Conference, September 26-28, 1973, Warren, Vermont. University Press of New England, Hanover, New Hampshire, 1975. p 201-215, 9 fig, 1 tab, 8 ref.

Descriptors: *Chlorination, *Disinfection, *Water treatment, *Wastewater treatment, Costs, Economic aspects, Design standards, Rural areas.

The need for a simple, economical, efficient, effective, and reliable means to disinfect drinking water and wastewater in low density areas is great. The erosion-type hypochlorinator, particularly of the split-flow design, appears to have the potential to provide such means. The operating characteristics of the split-flow type erosion feeder may be summarized as follows: (1) the flow of water into the hypochlorinator is split into two streams of water, with the smaller of the two streams being diverted into the dissolving chamber; (2) during the operating phase, the depth of water in the dissolving chamber is kept at a constant value by a fixed-level overflow weir; (3) during the shut-down or nonoperating phase, a weep hole drains the water in the dissolving chamber to a level that is lower than the lowest possible position of the hopper, thereby stopping the dissolving or eroding action of water on the disinfectant; and (4) the rate of application of the disinfectant may be varied by adjusting the depth of submergence of the hopper in the dissolving chamber. This type of disinfectant feeder is a simple, low cost, dependable device. Operation and maintenance do not require special skills. No power source is required to provide continuous automatic operation with a high degree of reliability. The principal shortcoming, which may be overcome in most situations, is that the dissolving chamber cannot be satisfactorily operated under a hydraulic head. (See also W89-11953) (Lantz-PTT)
W89-11970

THIRTY-FIVE YEARS OF USE OF A NATURAL SAND BED FOR POLISHING A SECONDARY-TREATED EFFLUENT.
Rensselaer Polytechnic Inst., Troy, NY. Dept. of Environmental Engineering.
D. B. Aulenbach, N. L. Clesceri, J. Tofflemire, and J. J. Ferris.
IN: Water Pollution Control in Low Density Areas: Proceedings of a Rural Environmental Engineering Conference, September 26-28, 1973, Warren, Vermont. University Press of New England, Hanover, New Hampshire, 1975. p 227-239, 4 fig, 1 tab, 5 ref.

Descriptors: *Sand, *Land disposal, *Secondary wastewater treatment, *Fate of pollutants, Wastewater treatment, Lake George, New York, Phosphorus, Dissolved solids, Alkalinity, Nitrates, Phosphates.

Sewage effluent applied to the sand beds at the Lake George Village, New York, sewage treatment plant enters the groundwater, flows in a generally northerly direction, and emerges in some form or another from the ground near West Brook, following which it flows into West Brook and ultimately into Lake George. The sandy soil of this area is adequate for the conventional treatment of the applied effluent. Reflecting the quality of the sewage effluent applied to the sand beds, the water emerging from the ground near West Brook is much higher in dissolved solids, alkalinity, and chloride than the natural groundwater in the area. These parameters are increased in West Brook as the stream flows past this area. Although insufficient data are available to make a positive statement concerning the nitrogen contributions from the sewage effluent, it does appear that the reduced nitrogen in completely oxidized to nitrate prior to its emergence from the ground and increases the nitrate content of the water of West Brook significantly. The total phosphorus content of the applied sewage effluent has been reduced by > 99% in its passage through approximately 2,000 ft of sand from the treatment plant to West Brook. There is little increase in the phosphate content of West Brook from the effluent. (See also W89-11953) (Lantz-PTT)
W89-11972

ON-SITE HOUSEHOLD WASTEWATER TREATMENT ALTERNATIVES--LABORATORY AND FIELD STUDIES.
Wisconsin Univ.-Madison. Small Scale Waste Management Program.
R. J. Otis, N. J. Hutzler, and W. C. Boyle.
IN: Water Pollution Control in Low Density Areas: Proceedings of a Rural Environmental Engineering Conference, September 26-28, 1973, Warren, Vermont. University Press of New England, Hanover, New Hampshire, 1975. p 241-265, 14 fig, 4 tab, 7 ref.

Descriptors: *Aerobic treatment, *Septic tanks, *Wastewater treatment, *Field tests, Biochemical oxygen demand, Suspended solids.

The management of wastewater discharged from the single family dwelling, motel, restaurant, or other establishment which is not connected to central sewerage is a major problem throughout the country. Currently, the only alternatives to the septic tank system: (1) the prevention of all development in unsuitable areas; (2) holding tanks; or (3) central sewerage are not satisfactory. Thus future economic development will be inhibited in many areas, and existing hazards will go uncorrected, unless effective alternative systems are found. Currently there are numerous alternatives available for the treatment of household wastewaters, including: (1) single-compartmented septic tanks; (2) multi-compartmented septic tanks; (3) continuous flow-extended aeration units receiving either raw or septic tank wastes; (4) batch-extended aeration units receiving raw wastes only; (5) rotating biological disk units; (6) a chemical precipitation and coagulation unit; (7) intermittent sand filters loaded with either septic tank effluent or aerobically treated waste; and (8) dry-feed chlorinators following sand filtration. In comparison between septic tanks and aerobic treatment units aerobic units were found to provide significantly higher biochemical oxygen demands (BOD) removals in comparison with septic tanks for units run in both the field and laboratory settings. Total suspended solids removals, however, were not significantly different between the two types of treatment in the field through significant differences were found in the laboratory. (See also W89-11953) (Lantz-PTT)
W89-11973

LOW COST WASTEWATER TREATMENT FACILITIES FOR RURAL AREAS.
Toronto Univ. (Ontario). Dept. of Civil Engineering.
P. H. Jones.
IN: Water Pollution Control in Low Density Areas: Proceedings of a Rural Environmental Engineering Conference, September 26-28, 1973, Warren, Vermont. University Press of New England, Hanover, New Hampshire, 1975. p 371-388, 8 fig, 3 tab, 19 ref.

Descriptors: *Wastewater treatment, *Costs, *Rural areas, *Wastewater treatment facilities, Oxidation, Water disposal, Activated sludge, Land disposal, Biological treatment, Aeration, Secondary wastewater treatment.

Wastewater treatment facilities for rural areas should have special attention paid to certain features. Plants should exhibit reliability without skilled help, be efficient under variable quality and quantity of flow, blend into the countryside without unsightly features, generate little solids for further handling, and, finally, be relatively free from odors. The design of such plants should consider the quality of effluent required in the light of characteristics of the receiving stream, its susceptibility to eutrophication, and the subsequent uses of said receiving stream. Design should also consider and provide for availability of land for accomodating the treatment unit and also for final disposal of effluent and/or sludge. Oxidation ponds in all their varieties have grown in popularity, because of their simplicity and low cost. The large area of land required is one major drawback of this process. A variety of activated sludge processes and modifications are considered, and some Ontario data presented suggests that process is less significant than flow. Alternative processes are the oxidation ditch, rotary biodisks, extended filtration, and submerged bed-aeration system. Land application may also be used for sewage, effluent, or sludge, but consideration must be given to the crops grown on this land and the possible public health effects either from pathogens or heavy metals. Effluent polishing may be required, but this is perhaps less likely than nutrient removal. Eutrophication is proving to be a problem in the smaller, shallow warm lakes frequently found in rural Canada and the United States. There are a variety of simple possibilities involving chemical addition and process modification which will remove substantial amounts of such nutrients as nitrogen and phosphorus. (See also W89-11953) (Lantz-PTT)
W89-11979

WASTEWATER TREATMENT FOR SMALL COMMUNITIES.
California Univ., Davis. Dept. of Civil Engineering.
G. Tchobanoglous.
IN: Water Pollution Control in Low Density Areas: Proceedings of a Rural Environmental Engineering Conference, September 26-28, 1973, Warren, Vermont. University Press of New England, Hanover, New Hampshire, 1975. p 389-427, 4 fig, 17 tab, 26 ref.

Descriptors: *Wastewater treatment, *Rural areas, Economic aspects, Design standards, Biological treatment, Filtration, Activated sludge processes, Stabilization ponds, Land disposal.

During the past ten years, concern over the design, construction, and operation of large regional systems has all but overshadowed interest in small treatment plants; however ore than 75 million people in this country are served by small systems of various design. Recently, as the words 'water quality control' have taken on new meaning--many of the problems associated with the design and operation of small treatment plants have become more painfully apparent. Therefore, the purposes of this paper are: (1) to define some of the general problems associated with small plants (design, operation and maintenance, budget limitations and communications); (2) to review alternative treatment processes that can be used for small communities (Imhoff tank, rotating biological disk process, trickling water processes, activated sludge processes, stabilization pond processes, and land disposal processes); (3) to review some design considerations that are of major importance for small plants (the characteristics of the incoming wastewater, the design of secondary settling tanks, plant control, maintenance, and power requirements); and (4) to compare the alternative treatment processes from an economic standpoint. (See also W89-11953) (Lantz-PTT)
W89-11980

CLIVUS-MULTRUM SYSTEM: COMPOSTING OF TOILET WASTE, FOOD WASTE, AND SLUDGE WITHIN THE HOUSEHOLD,
National Swedish Environment Protection Board, Solna.

C. R. Lindstrom.
IN: Water Pollution Control in Low Density Areas: Proceedings of a Rural Environmental Engineering Conference, September 26-28, 1973, Warren, Vermont. University Press of New England, Hanover, New Hampshire, 1975. p 429-444, 7 fig, 5 ref.

Descriptors: *Wastewater treatment, *Composting, Solid wastes, Organic material, Biodegradation, Dewatering, Decomposition, Bacteria, Sludge drying.

The present division between solid and liquid waste is not necessary or, for that matter, even natural. If, in fact, the organic material, including soiled paper, that now is disposed of as solids is mixed with toilet wastes, the conditions for composting processes are almost ideal. Heat production and moisture in the material are favorable, as well as the balance between carbon, nitrogen, and phosphorus. This also has great importance for the end product and its value as a fertilizer. Unlike ordinary chemical fertilizers, this end product also contains trace metals like sodium, iron, magnesium, zinc, etc., which are of great importance for balanced soil conditions. The end product is a humus soil material with an odor similar to that of composted leaves. The average amount corresponds to a few buckets/person/year. The important thing is that it appears possible to process the organic waste, including the toilet deposits, safely and hygienically within the household into a harmless and even useful end product. The Clivus compost reactor works on the principles of gravity, capillary action, and a special ventilation system. The composting material is enclosed in an impervious container. This container is connected to the toilet and kitchen refuse openings by means of two chutes. A vent allows the gases produced in the process to escape. A layer of topsoil placed on the sloping bottom contains the bacteria necessary for the decomposition of the toilet and kitchen wastes. Because the inside of the converter is kept at a lower pressure than the outside, there is no odor either in the bathroom or in the kitchen, which are both actively ventilated when the covers are opened. The first stage of the process in which the larger particles are broken down and during which the greatest heat produced is rapid, whereas the secondary process, the mineralizing of the material, takes months and years. The total amount of finished compost produced/person/year is about 10 gallons of soil. By contrast, a conventional toilet uses and pollutes 10,000 gallons of clean water/person/year for transportation alone. (See also W89-11953) (Lantz-PTT)
W89-11981

TREATABILITY OF SEPTIC TANK SLUDGE.
New York State Coll. of Agriculture and Life Sciences, Ithaca. Dept. of Agricultural Engineering.
W. J. Jewell, J. B. Howley, and D. R. Perrin.
IN: Water Pollution Control in Low Density Areas: Proceedings of a Rural Environmental Engineering Conference, September 26-28, 1973, Warren, Vermont. University Press of New England, Hanover, New Hampshire, 1975. p 445-477, 15 fig, 9 tab, 20 ref.

Descriptors: *Sludge drying, *Septic tanks, *Wastewater treatment, Biological treatment, Anaerobic digestion, Chemical oxygen demand, Biochemical oxygen demand, Biodegradation, Suspended solids, Aerobic digestion, Bacteria, Dewatering, Chemical treatment.

Sludge drained from septic tanks is a highly complex waste but is amenable to treatment by common biological, chemical, and physical processes. Significant soluble chemical oxygen demand (COD) reductions were observed with aerobic and anaerobic treatment. Reduction in the aerated lagoons averaged 74%, while that in anaerobic digesters averaged 64% for similar hydraulic detention periods. These reductions resulted in effluent biochemical oxygen demand (BOD) values < 20 mg/L in most units, even though the COD concentration was 580 to 1,000 mg/L. The average decay rates of the biodegradable COD and volatile suspended solids (VSS) determined for the aerobic batch units were the same. The composition of septage may inhibit bacterial activity in anaerobic digesters. Raw septage should not be applied to sand drying beds because of its slow dewatering rate. A linear relationship exists between dewaterability of septage as measured by the capillary suction time (CST) method and the rate of dewatering on a sand drying bed. This relationship indicated that a septage sample with a CST of 50 seconds or less could be treated on a sand drying bed without excessively long drainage periods. Chemical coagulant aids were found to be effective at concentrations between 2% and 4% in increasing the dewaterability of all septage samples to the CST of 50 seconds required for sand bed utilization. In reviewing the treatability characteristics, it appeared with the use of existing municipal treatment facilities to treat septage should not be recommended. Instead, a centrally located treatment facility combining the following unit processes would be a feasible alternative: covered receiving tank, aerobic lagoon or aerobic digestion, and sand beds or direct land disposal. (See also W89-11953) (Lantz-PTT)
W89-11982

ENVIRONMENTAL DEGRADATIONS BY MICROORGANISMS AT LOW TEMPERATURES: WASTEWATER TREATMENT.
Norges Tekniske Hoegskole, Trondheim. Selskapet for Industriell og Teknisk Forskning.
G. Halmo.
Available from the National Technical Information Service, Springfield, VA 22161, as PB88-219639. Price codes: E04 in paper copy, E04 in microfiche. December 30, 1987. 33p, 14 fig, 8 tab.

Descriptors: *Microbial degradation, *Cold resistance, *Wastewater treatment, *Cold regions, *Biodegradation, Nitrates, Denitrification, Nitrification, Oxidation, Bacteria, Temperature, Nitrogen, Activated sludge process, Suspended solids, Culturing techniques, Enzymes, Growth rates, Nutrients, Ammonium, Nitrogen removal, Biological wastewater treatment.

Two projects were initiated in the late seventies to study the use of selected low temperature sludges for biological wastewater treatment. The aim was both to find the parameters for full-scale application as well as to obtain a better understanding of low temperature bacteria and their limitations. The proteolytic and amylolytic enzymatic activities of the two sludge systems were studied. In these experiments complete artificial fluids with mineral salts and casein and/or starch were used. If necessary, some ammonium chloride was added to give a balanced element composition. The influent strength was maintained at 400 mg chemical oxygen demand (COD)/L. It was found that the proteolytic and amylolytic activity at the in situ temperature seemed to be sufficient to satisfy the protein and carbohydrate consumption rates. The optimal temperatures for proteolytic and amylolytic activity in the low temperature sludge were on the average found to be 10-13 C lower than for the corresponding activities in the high temperature sludge. The main objective of the work was to try to enrich for a denitrifying sludge with psychrophilic characteristics and to compare its efficiency with a mesophilic one. The difference in the specific denitrification rate between low--and high-temperature sludges was quite pronounced. In the range 0-8 C the low temperature sludge had a 3-4 times higher rate than the high temperature one, with a maximum activity of about 8 mg NO3(-)/nanogram dry weight, at 14-15 C. Two nitrifying sludges were enriched for at 4 C, on a synthetic growth medium and by use of the low temperature activated sludge as inoculum. Both cultures were very slow-growing at 4 C. Nitrogen was very efficiently removed--in the periods when ammonium was oxidized to nitrate in the nitrification unit, 94-97% of the influent inorganic nitrogen was removed. Separately, denitrification gave up to 98-99% of theoretical reduction, with a final effluent of 0.4 mg NO3-N/L. (Lantz-PTT)
W89-11994

HWHM 88: HAZARDOUS WASTES AND HAZARDOUS MATERIALS.
For primary bibliographic entry see Field 5E.
W89-12002

DESIGN AND OPERATIONAL CHARACTERISTICS OF A COLLECTION TREATMENT/RECHARGE/FLUSHING GROUNDWATER REMEDIATION SYSTEM.
PRC Environmental Management, Inc., Chicago, IL.
For primary bibliographic entry see Field 5G.
W89-12009

FERROUS SULFATE/SODIUM SULFIDE CHROMIUM REDUCTION METALS PRECIPITATION.
Air Force Engineering and Services Center, Tyndall AFB, FL.
C. J. Carpenter.
IN: HWHM 88: Hazardous Wastes and Hazardous Materials. Proceedings of the 5th National Conference held April 19-21, 1988, Las Vegas, Nevada. 1988. p 52-56, 2 fig, 3 tab, 7 ref.

Descriptors: *Chromium removal, *Wastewater treatment, *Ferrous sulfate, *Sodium sulfide, *Chemical precipitation, *Industrial wastewater, Chemical treatment, Sludge, Temperature, Cyanide, EDTA, Orthophosphates, Electroplating.

The feasibility of using sodium sulfide and ferrous sulfate to reduce the hexavalent chromium to precipitate the metals and thereby decrease sludge production and chemical usage was determined. Phase I of the project, jar and dynamic testing, showed that the sodium sulfide/ferrous sulfate process was a viable method for reducing hexavalent chromium and removing heavy metals from the Tinker AFB industrial wastewater with a significant decrease in sludge production and treatment costs. In Phase II, pilot-plant field-verification studies were conducted to evaluate the chemical and physical parameters of the chromium reduction process, the precipitation and clarification process, and the activated sludge system. Sludge production and chemical usage of this process were evaluated and compared to the sulfuric acid/sulfur dioxide/lime process. The impact of a procedure for switch-over to the sodium sulfide/ferrous sulfate process was investigated. Additional testing was conducted to determine the effects of orthophosphate, ethylene diaminetetra-acetic acid, cyanide, additional metals, flow rate and temperature on chromium reduction, metal removal and the activated sludge system. Based on the results of Phase II, implementation of a full-scale production system was recommended and funded. The system is expected to be operational by June 1988. (See also W89-12002) (Lantz-PTT)
W89-12012

DIOXIN: TREATMENT WITH OZONE.
Capital Controls Co., Inc., Colmar, PA.
S. S. Pierson, A. R. Joel, and H. H. Rump.
IN: HWHM 88: Hazardous Wastes and Hazardous Materials. Proceedings of the 5th National Conference held April 19-21, 1988, Las Vegas, Nevada. 1988. p 62-66, 6 fig, 3 tab, 6 ref.

Descriptors: *Wastewater treatment, *Ozonation, *Dioxins, Chlorinated hydrocarbons, Ozone, Chemical treatment, Hydrogen ion concentration, Chemical reactions, Chlorine.

Dioxins are created as by-products during the production of chlorophenols and chlorinated biphenyls. Dioxin and furan-containing drainage and wastewaters present waste disposal problems. Therefore, tests have been conducted to determine the effectiveness of ozone treatment. Polychlorinated dibenzo-p-dioxin (PCDD) and polychlorinated dibenzofuran (PCDF) can be degraded by ozonation in an alkaline aqueous medium. No reaction occurs in acid solutions. Degradation rates of at least 99% were observed after the reaction conditions (pH, temperature) had been optimized. The substances investigated contained three to eight chlorine atom, had different reaction rates and the reaction with ozone was determined to be a second order reaction. The rate of reaction de-

pends on the number and configuration of the chlorine atoms. The selective detection and quantitative determination of PCDD-and PCDF-traces was performed by capillary gas chromatography in combination with a mass selective detector. Reaction products may be fumaric-, maleic-, meso tartaric-, hydroxyacetic-, oxoethanoic acids and others. (See also W89-12002) (Author's abstract)
W89-12013

CHEMICAL TREATMENT: AN INEXPENSIVE ALTERNATIVE TO HANDLING OILY SLUDGE.
Emulsions Control, Inc., National City, CA.
S. Delchad.
IN: HWHM 88: Hazardous Wastes and Hazardous Materials. Proceedings of the 5th National Conference held April 19-21, 1988, Las Vegas, Nevada. 1988. p 85-88, 3 fig, 3 tab, 2 ref.

Descriptors: *Chemical treatment, *Wastewater treatment, *Oil wastes, *Sludge digestion, Emulsions, Chemical treatment, Sludge, Case studies.

An oily sludge is a stable mixture (emulsion) of oil, water and solids. The stability of oily sludges is attributable to the presence of small amounts of contaminants, referred to as emulsifiers. These emulsifiers prevent phase separation expected from normal gravity differentials. Oily water, wet oil and oil-coated solids acquire new specific gravities, thus impeding separation. Demulsifiers are chemicals formulated from an array of surface-active ingredients to overcome the stabilizing forces of the emulsifiers. They act to de-oil and disperse solid particulates and bring about separation of oil, water and solids into distinct phases. Factors which affect demulsifier performance are: temperature/viscosity, solids and other trace contaminants, type of treatment equipment, settling time, demulsifier type and concentration, and mixing of the demulsifier. The theory and application of demulsification technology are outlined with special emphasis on oily sludge. An overview of the various types of sludge and their properties is presented. Recognizing that chemical treatment is only one of several practical processes used in dealing with industrial sludges, a qualitative comparison is offered summarizing the advantages and disadvantages of these processes. In conclusion, a case history is presented describing in detail the successful treatment of refinery sludge using a versatile and proven chemical demulsifier. (See also W89-12002) (Lantz-PTT)
W89-12016

HAZARDOUS WASTE REDUCTION IN THE PESTICIDE FORMULATING INDUSTRY.
Environmental Science and Engineering, Inc., Sacramento, CA.
R. V. Bowen.
IN: HWHM 88: Hazardous Wastes and Hazardous Materials. Proceedings of the 5th National Conference held April 19-21, 1988, Las Vegas, Nevada. 1988. p 90-95, 1 fig, 7 tab, 9 ref.

Descriptors: *Wastewater treatment, *Hazardous wastes, *Pesticides, *Waste management, Management planning, Surveys, Economic aspects, Waste audits, Recycling, Waste recovery.

In support of the State of California Department of Health Services hazardous waste reduction program, a waste audit study of the pesticide formulating industry was performed. The objective was to evaluate waste management methods currently practiced by this industry to develop recommendations for waste reduction. An additional study objective was the development of a self-audit format which could be used by pesticide formulating plant personnel to conduct their own audits. Waste reduction information was gained primarily by conducting audits of three pesticide formulating plants. In the audits, pesticide formulating and packaging operations were observed, sources of hazardous waste were identified, waste management methods were evaluated and existing waste reduction techniques were assessed. The findings of the waste audit study were used to develop recommended waste reduction techniques involving waste recycle, treatment and source reduction that are applicable to the pesticide formulating industry as a whole. The costs/economic benefits of implementing the waste reduction techniques also were addressed in this study. Finally, the study findings were used in the development of the self-audit format which serves as a checklist for the industry to systematically evaluate their current sources of waste generation, waste management practices and potential waste reduction techniques that may apply to their plants. (See also W89-12002) (Author's abstract)
W89-12017

AUTOMATED PRETREATMENT OF ELECTROPLATING WASTE AT TINKER AFB, OK.
Oklahoma City Air Logistics Center, Tinker AFB, OK.
M. F. Herlacher.
IN: HWHM 88: Hazardous Wastes and Hazardous Materials. Proceedings of the 5th National Conference held April 19-21, 1988, Las Vegas, Nevada. 1988. p 109-113, 3 fig, 2 tab.

Descriptors: *Water reuse, *Industrial wastewater, *Electroplating, *Metal-finishing wastes, *Wastewater treatment, *Pretreatment of wastewater, Automation, Recycling, Computers, Waste recovery, Cyanide, Ozone, Nickel.

A system was designed to recover nickel and chrome, oxidize cyanide with Photozone activated oxygen, precipitate the residual metals and remove organic contaminants from the discharge to recycle water for reuse in the plating facility. The system is designed to treat concentrated and dilute wastewater at a flow rate of 140 gal/min. The total volume of spent concentrated plating solutions is 127,000 gal/yr. The system includes computer controls to maintain the process logs in addition to controlling the waste treatment process. The processes controlled include metal recovery, metal removal, Photozone oxidation and conductivity controllers. The metal recovery system is a retrofit of existing equipment. The existing equipment consists of chrome scrubbers for chrome recovery and ion exchange for nickel recovery. The equipment added to the chrome system is a cation exchanger to purify the chrome present in the rinse waters and a climbing film evaporator to concentrate the chrome for reuse in the plating baths. The nickel recovery upgrade is to allow the present system to recover nickel sulfamate which will be better utilized in the plating process. The cyanide destruction process is a break from the traditional alkaline chlorination method. The cyanide destruct process gas that Photozone activated oxygen to produce an oxidant gas that will be injected into the waste cyanide stream. The primary oxidant in the Photozone process is ozone. The ozone reacts with cyanide to yield carbon dioxide. The main advantages of Photozone are the elimination of pretreating the input gas, the greater destructive power of ozone and the oxygenated effluent stream. The metal removal process uses standard precipitation methods to oxidize the dissolved metals using pH adjustment and sedimentation to remove the solids from the waste stream. The effluent is further treated with a sand filter and carbon adsorption. The resultant water will be recycled back to the demineralizers for reuse in the plating facility. The projected recycle rate is 60%. (See also W89-12002) (Lantz-PTT)
W89-12018

WASTE MINIMIZATION AUDIT MANUAL FOR THE PRINTED CIRCUIT BOARD INDUSTRY.
PRC Environmental Management, Inc., San Francisco, CA.
T. P. Adkisson, and D. P. DeRienzo.
IN: HWHM 88: Hazardous Wastes and Hazardous Materials. Proceedings of the 5th National Conference held April 19-21, 1988, Las Vegas, Nevada. 1988. p 121-127, 6 fig, 2 ref.

Descriptors: *Water audits, *Water reuse, *Wastewater treatment, *Manuals, *Industrial wastewater, *Waste management, Chemical treatment, Recycling, Management planning, Sludge digestion, Waste reduction, Small businesses.

The State of California Department of Health Services has funded a program to develop a series of self-audit manuals designed to help smaller business establishments identify opportunities for waste minimization. The critical elements of a successful waste minimization program are: management commitment; personnel involvement; access to background data; and resources to obtain additional data. The audit process can be broken down into several segments: audit team preparation; initial survey; background data analyses; comprehensive plant assessment; and evaluation of waste minimization opportunities. Evaluating waste minimization opportunities is a two-step process. First, after background data are obtained, potential waste minimization technologies or procedures should be identified and reviewed. Second, after completion of the plant assessment, the potential waste minimization technologies or procedures can be fully assessed. The audit should evaluate each waste minimization opportunity based on two considerations: (1) the feasibility of implementation, keeping in mind the production process parameters necessary to ensure product quality, and (2) the payback of investment, considering the cost of implementation and savings in material usage and waste handling costs. Several techniques are available for evaluating the potential for waste minimization in the various processes used at a PC board manufacturing plant: (1) improving rinse efficiency; (2) rinsewater recycling; (3) drag-out reduction; (4) source segregation and process bath maintenance; (4) process bath chemical recovery; and (5) waste treatment sludge. The self-audit manual developed for the PC board manufacturing industry includes an audit protocol designed to explain the audit process and a series of work sheets designed to lead the audit team through a facility audit. (See also W89-12002) (Lantz-PTT)
W89-12019

AIR FORCE SYSTEMS COMMAND WASTE MINIMIZATION STUDY.
Earth Technology Corp., Alexandria, VA.
M. Savage, and F. P. Gallagher.
IN: HWHM 88: Hazardous Wastes and Hazardous Materials. Proceedings of the 5th National Conference held April 19-21, 1988, Las Vegas, Nevada. 1988. p 128-130, 4 tab.

Descriptors: *Waste reduction, *Waste audits, *Waste management, *Wastewater treatment, *Hazardous wastes, Waste disposal, Management planning, Economic aspects, Industrial wastes, Waste characteristics.

In response to EPA and DoD waste minimization initiatives, a waste minimization study was conducted on behalf of Air Force Systems Command at 10 Systems Command installations. The purpose of the studies was to minimize the amount of hazardous waste generated at the installations and to reduce the amount of waste being landfilled by 50%, by the year 1992. The project involved definition of waste generation and management practices at each installation and systems analysis of generating processes; identification and technical/economic feasibility analysis of waste minimization opportunities; stimulation of technology transfer and increasing facility personnel awareness of the importance of waste minimization; identification of research and development and capital requirements to further minimize waste generation; and evaluation of data management systems for the ability to track materials management and waste minimization progress. Although types and quantities of hazardous wastes generated varied with the size and function of the installation, some general conclusions were drawn. Petroleum, oils, lubricants and painting wastes contribute significantly to the total waste stream at each installation. Other wastes, such as printed circuit board etchants, may also make significant contributions to the total waste stream from a particular installation. Minimization opportunities identified for these wastes included process modifications, material subsitutions, source reduction and alternative recovery/treatment options. An average reduction of > 50% by weight is achievable at these installations through implementation of minimization opportunities. It was noted that improved waste tracking will en-

hance waste management activities at Systems Command installations. (See also W89-12002) (Author's abstract)
W89-12020

DEVELOPMENT AND OPERATION OF AN EFFICIENT CYCLONIC INCINERATION DEMONSTRATION SYSTEM FOR INDUSTRIAL WASTEWATER.
Institute of Gas Technology, Chicago, IL.
M. J. Khinkis, V. Kunc, and P. J. Romanovich.
IN: HWHM 88: Hazardous Wastes and Hazardous Materials. Proceedings of the 5th National Conference held April 19-21, 1988, Las Vegas, Nevada. 1988. p 230-236, 7 fig, 3 tab.

Descriptors: *Wastewater treatment, *Industrial wastewater, *Incineration, Heat treatment, Solids.

The cyclonic combustion concept, which provides high combustion-intensity and high combustion-efficiency with low excess air, offers many advantages for waste incineration over commercially available incinerators. The cyclonic incinerator allows better mixing and temperature uniformity, high destruction efficiency, a wider range of operating parameters, greater flexibility to variation in waste properties, dry ash and/or molten slag operation and more efficient heat recovery at reduced capital and operating costs. A successful demonstration system has been operated consisting of a wastewater handling system; a compact cyclonic incinerator with an ash/slag receiver, capable of operating either in dry or slaggin modes; a heat recovery boiler; an air heater; and a baghouse. Performance tests, including a final 500-hr, continuous system operation at the industrial site, demonstrated stable, reliable, high-efficiency, low, pollutant-emission incineration of 40 gal/hr of wastewater containing up to 50% solids (heating value of about 3000 Btu/lb). The heat contribution ratio of waste to auxiliary fuel, on a Btu basis, averaged 55:45. Major operating parameters during the final operation included 2.15 mega-Btu/hr total firing rate, 2050 F combustion temperature, 325 F air preheat and specific heat release of 0.12 mega-Btu/hr/cu ft with 20% excess air. The carbon monoxide concentration in the concentration in the combustion products was usually below 100 parts per million (ppm). The system generated about 1100 lb/hr of process steam. A sufficient data base was generated for design and construction of a larger, commercial system. (See also W89-12002) (Lantz-PTT)
W89-12033

STEEL MILL CLOSURE.
ERT, Inc., Camarillo, CA.
For primary bibliographic entry see Field 5G.
W89-12043

CLOSURE OF A RCRA IMPOUNDMENT BY BIODEGRADATION AND FIXATION.
Monsanto Chemical Co., St. Louis, MO.
For primary bibliographic entry see Field 5E.
W89-12045

AUTOMATED ONDA CORRELATION MODELING COMPARED TO ACTUAL STRIPPING TOWER PERFORMANCE.
HDR Engineering, Inc., Omaha, NE.
For primary bibliographic entry see Field 5F.
W89-12062

CATALYTIC DESTRUCTION OF HAZARDOUS ORGANICS IN AQUEOUS WASTES.
Battelle Pacific Northwest Labs., Richland, WA.
E. G. Baker, and L. J. Sealock.
IN: HWHM 88: Hazardous Wastes and Hazardous Materials. Proceedings of the 5th National Conference held April 19-21, 1988, Las Vegas, Nevada. 1988. p 459-462, 3 fig, 6 tab, 3 ref.

Descriptors: *Catalysis, *Wastewater treatment, *Hazardous wastes, *Organic compounds, Methane, Carbon dioxide, Polycyclic aromatic hydrocarbons, Phenol, Chlorinated organic compounds, Temperature.

The first 6 months of testing using a 1-L batch reactor demonstrated that catalytic destruction is useful as a means of permanent remediation of aqueous waste streams containing hazardous organics. With organic materials, destructions were 99% and often approached 99.9%. The organics are converted almost entirely to methane and carbon dioxide. The catalytic destruction process can treat all types of non-chlorinated organics including aliphatics, polycyclic aromatics and phenolics. It also shows promise for destroying chlorinated organics, although additional development is necessary for this application. The process can treat aqueous wastes with a wide range of organic concentrations but it is probably most economic for streams containing 0.1 to 10.0% organics. For wastewaters containing < 0.1% non-chlorinated organics, a preconcentration step may be appropriate. The process is quite simple; it requires only a pump, heat exchangers, a catalytic reactor and a gas/liquid separator. Based on the results of the experimental studies, the optimal operating conditions in the catalytic reactor are 350 to 400 C and 2000 to 4000 pounds/sq in gas. Testing is currently under way in a 1-L, continuous flow, reactor. These tests will provide engineering data for a preliminary design and cost estimate for a large-scale system. (See also W89-12002) (Lantz-PTT)
W89-12065

CENTRAL HAZARDOUS TOXIC WASTE FACILITY.
Ebasco Services, Inc., New York.
H. S. Cohen, and C. Tsang.
IN: HWHM 88: Hazardous Wastes and Hazardous Materials. Proceedings of the 5th National Conference held April 19-21, 1988, Las Vegas, Nevada. 1988. p 549-551, 11 ref.

Descriptors: *Wastewater treatment, *Wastewater facilities, *Hazardous wastes, Sludge digestion, Solvents, Waste recovery, Inorganic compounds, Organic compounds, Ozonation, Chemical treatment, Solvents, Separation techniques.

The Centralized Hazardous and Toxic Waste Processing Facility concept would utilize the latest technology to process and control hazardous material. A proposed facility is designed with sufficient security to keep out intruders. All process areas including tank farm areas are fenced such that only authorized personnel may enter. Separate tanks are used for each type of waste and each tank varies in capacity from several thousand to tens of thousands of gallons depending on the anticipated volume of waste expected. The function of a centralized facility is to process and dispose of a large percentage of the waste produced in a state or region. Therefore, it will be necessary for any facility to have a number of different chemical treatment processes. The hazardous wastes have been divided into six major categories and a treatment to safely dispose of each has been proposed. The major waste categories are: inorganic aqueous waste, inorganic sludges, organic liquids, organic sludges, solid waste and solvents. The inorganic aqueous waste treatment system is designed to process non-flammable hazardous inorganic liquid wastes which normally have a low concentration of suspended solids. The treatment system consists of collection tanks, sample tanks, transfer pumps, mixing tanks and a chemical addition system for lime, oxidizing agents, reducing agents and other necessary additives. The Inorganic Sludge Treatment System immobilizes the sludge by chemical fixation or solidification. The treatment system consists of collection tanks, a lime precipitation section, a sulfide polishing section and a solidification section. Ozone is used to destroy organics in solution. In the process, ozone gas bubbles through the wastewater in the presence of ultraviolet light to oxidize the organics. It is anticipated that three different treatment processes will be required for organic sludge: a biological treatment system, a wet air oxidation (WAO) unit and an incinerator. Solvents used by industry are generally discarded after they have been contaminated. In many cases it may be economical to reprocess and recover solvents due to the increasing cost of the solvents. The solvent recovery process is designed to segregate and recover organic solvent from wastes. (See also W89-12002) (Lantz-PTT)
W89-12074

SYMPOSIUM ON ENVIRONMENTAL TECHNOLOGY AND MANAGEMENT, 1988. MAIN THEME: ADVANCED BIOLOGICAL WASTEWATER TREATMENT.
Lenox Inst. for Research, Inc., MA.
Available from the National Technical Information Service, Springfield, VA 22161, as PB89-101000. Price codes: A06 in paper copy, A01 in microfiche. Technical Report No. LIR/08/88/313, August 30, 1988. 159p. Edited by Lawrence K. Wang and Mu Hao S. Wang.

Descriptors: *Advanced wastewater treatment, *Environmental engineering, *Biological wastewater treatment, *Symposium, *Wastewater treatment, Costs, Biochemical oxygen demand, Anaerobic digestion, Filtration, Biological treatment, Metal-finishing wastes.

Recognizing that cost-effective wastewater treatment is badly needed and subject to constant improvement, the Lenox Institute for Research and the State of New York, Department of Environmental Conservation, give a series of technical presentations aiming at meeting the need for innovative and cost-effective biological wastewater treatment processes. The symposium increases understanding in the area of general biological treatment systems, and helps develop specialized expertise in biotechnology that will enable attendants to assume responsibilities for selection or design of advanced but more cost-effective process system for biochemical oxygen demand and nutrient removal. Eight technical papers are included: (1) Active Biomass Retention--The Key to Anaerobic Process Efficiency; (2) A Comparison of Anaerobic Filter and Anaerobic Expanded/Fluidized Bed Processes; (3) Innovative Engineered Systems for Biological Treatment of Contaminated Surface and Groundwater; (4) Application of the Two-Phase Anaerobic Fluidized Bed Process to the Treatment of Corn Processing Wastewater; (5) Application of the UASB-Reactor for Anaerobic Treatment; (6) Biological Treatment of Metalworking Wastewaters; (7) Coupled Biological Downflow Fluid Bed Reactor Treatment of Synfuels Wastewater; and (8) The No-Space Biological Wastewater Process. (See W89-12082 thru W89-12089)(Author's abstract)
W89-12081

ACTIVE BIOMASS RETENTION: THE KEY TO ANAEROBIC PROCESS EFFICIENCY.
P. M. Sutton.
IN: Symposium on Environmental Technology and Management, 1988. Main Theme: Advanced Biological Wastewater Treatment. Technical Report No. LIR/08/88/313, August 30, 1988. p 2-11, 3 fig, 5 tab, 2 ref.

Descriptors: *Advanced wastewater treatment, *Activated sludge process, *Wastewater treatment, *Anaerobic digestion, *Biological wastewater treatment, Biomass, Industrial wastewater, Biological treatment, Membrane processes, Food-processing wastes, Fluidized bed process, Economic aspects.

The efficacy of any anaerobic system is dependent on maintaining a high active biomass concentration in the biological reactor. It is the purpose of this paper to discuss the application of the Anitron fixed-film system to the treatment of wastewater resulting from the refining of soybeans, and the application of membrane anaerobic reactor system (MARS) to the treatment of wastewaters resulting from the processing of wheat flour and the manufacturing of cheese. In addition, information is presented concerning: the technical and economic considerations which govern the selection of the anaerobic fluidized bed versus the membrane reactor for treatment of a specified wastewater; and the process and system scale-up results from operation of pilot and full-scale fluidized bed and membrane reactor systems. The anaerobic fluidized bed system and the membrane anaerobic reactor system are highly efficient but simple technologies for pretreatment of a variety of industrial

wastewater. The key to process efficiency is associated with the capability to build up and retain a high active biomass concentration in the microbial reactors of the systems. The selection of one system or the other for the treatment of a specific industrial wastewater will be dictated by both economical and technical considerations. Results from operation of pilot and full-scale Anitron and MARS plants attest to the successful scale-up of these innovative anaerobic fixed-film and suspended growth biological processes. Full-scale performance information confirm results developed at the pilot-scale level. (See also W89-12081)(Lantz-PTT)
W89-12082

COMPARISON OF THE ANAEROBIC FILTER AND THE ANAEROBIC EXPANDED/FLUIDIZED BED PROCESSES.
Massachusetts Univ., Amherst.
M. S. Switzenbaum.
IN: Symposium on Environmental Technology and Management, 1988. Main Theme: Advanced Biological Wastewater Treatment. Technical Report No. LIR/08/88/313, August 30, 1988. p 13-18, 2 fig, 1 tab, 11 ref.

Descriptors: *Filtration, *Biological wastewater treatment, *Advanced wastewater treatment, *Anaerobic digestion, *Fluidized bed process, *Wastewater treatment, Filtration, Model studies, Comparison studies, Data interpretation, Biofilms, Sanitary engineering.

The anaerobic filter and the anaerobic expanded/fluidized bed processes represent advances in wastewater treatment technology for processing inorganic wastes. Literature data for both processes is presented and discussed. In addition, a recent biofilm model is used to compare the substrate flux rates of both systems. Over a range of similar bulk substrate concentrations, the expanded bed was shown to have higher substrate flux rates per unit surface area then anaerobic filters. This is partially due to the fact that expanded beds have lower liquid layer depths and higher surface area per unit volume ratios than anaerobic filters. This would result in smaller reactor volumes and hence greater system economy when using the expanded/fluidized bed reactor systems. (See also W89-12081)(Lantz-PTT)
W89-12083

INNOVATIVE ENGINEERED SYSTEMS FOR BIOLOGICAL TREATMENT OF CONTAMINATED SURFACE AND GROUNDWATER.
Dorr-Oliver, Inc., Stamford, CT.
P. M. Sutton.
IN: Symposium on Environmental Technology and Management, 1988. Main Theme: Advanced Biological Wastewater Treatment. Technical Report No. LIR/08/88/313, August 30, 1988. p 21-41, 4 fig, 5 tab, 1 ref.

Descriptors: *Water pollution prevention, *Advanced wastewater treatment, *Wastewater treatment, *Biological wastewater treatment, Biological treatment, Anaerobic digestion, Aerobic treatment, Fluidized bed process, Membrane processes, Water quality control, Recycling, Ultrafiltration, Microbial degradation, Biodegradation, Volatile organic compounds.

Improved biotreatment techniques represent an economical and effective means of complying with new environmental legislation calling for control of toxic and hazardous organic and inorganic substances. Microbiological research has expanded current knowledge about the biotreatability of complex organics. By combining this knowledge with innovative reactor design concepts, an efficient engineered system for the treatment and detoxification of contaminated water and wastes, has been developed. The systems are based on the aerobic and anaerobic biological fluidized bed and membrane biological reactor concepts. Physical-chemical mechanisms for contaminant removal are an inherent part of the systems or can be readily integrated into the systems. The principles of the fluidized bed process have been incorporated into full-scale aerobic and anaerobic configurations through the development of the Oxitron and Anitron systems. The membrane bioreactor represents an advanced suspended growth reactor in which a high active microbial concentration (12,000 to 30,000 mg/L volatile suspended solids) is achieved through the use of ultrafiltration for biomass-effluent separation and subsequent recycle to the biological reactor. Commercial embodiments of the concept in aerobic or anaerobic configurations are represented by the Membrane Aerobic or Anaerobic Reactor System (MARS). The Oxitron/Anitron and MARS concepts overcome many issues of concern in applying microbial methods for treatment of hazardous wastewaters. The systems provide high volumetric efficiency, maximum opportunity for treatment of slowly biodegradable or recalcitrant compounds, can withstand microbially toxic/inhibitory feed inputs, allow treatment of volatile organics with little or no stripping, and result in the production of minimal residual by-products (excess biomass or other residuals). Examples of complex organics treatable in one or more of the systems include toluene, methyl ethyl ketone, napthalene, trichloroethylene, and pentachlorophenol. To date, mobile/transportable and permanently installed Oxitron/Anitron and MARS systems have been applied for treatment of a variety of toxic organic and inorganic compounds. (See also W89-12081)(Lantz-PTT)
W89-12084

APPLICATION OF THE TWO-PHASE ANAEROBIC FLUIDIZED BED PROCESS TO THE TREATMENT OF CORN PROCESSING WASTEWATER.
Dorr-Oliver, Inc., Stamford, CT.
D. J. Kothari, A. Y. Li, and T. J. Kontol.
IN: Symposium on Environmental Technology and Management, 1988. Main Theme: Advanced Biological Wastewater Treatment. Technical Report No. LIR/08/88/313, August 30, 1988. p 43-771, 8 fig, 5 tab, 10 ref.

Descriptors: *Advanced wastewater treatment, *Wastewater treatment, *Anaerobic digestion, *Fluidized bed process, *Food-processing wastes, *Biological wastewater treatment, Activated sludge process, Methane, Chemical oxygen demand, Suspended solids, Biochemical oxygen demand, Corn.

The corn wet milling industry processes corn to produce starch, oil, corn syrup, and animal feed. Both the feed-producing and starch-manufacturing process evolve a process wastewater containing approximately 3% of the corn in soluble form. The Anitron system is the commercial embodiment of the fixed-film fluidized bed process providing a means of optimizing the volumetric efficiency of the anaerobic process while ensuring the maximum tolerance to shock load conditions. The following conclusions can be drawn from the two-phase Anitron pilot plant studies conducted on corn processing wastewater and the waste activated sludge (WAS) recycled from the existing aerobic plant at American Maize's Hammond, Indiana plant: (1) the anaerobic biological fluidized bed system is applicable to the treatment of corn processing wastewaters (At a volumetric loading as high as 25.4 kg chemical oxygen demand (COD)/cu m/day, reductions of $>$ 86% COD and 83% biochemical oxygen demand (BOD) can be achieved.); (2) the Anitron system can treat additional WAS at 2% of the total wastewater flow with no effect on process performance; (3) methane yield varied from 0.21 to 0.31 cu m/kg COD removed, with methane content ranging from 63-73% in the biogas; (4) biomass net yield varied from 0.07 to 0.09 kg volatile suspended solids (VSS); (5) shock loads as high as eight times the operating load were absorbed by the two-phase Anitron system without adversely affecting the system; and (6) suspended solids resulting from waste biomass in the effluent can be efficiently concentrated with the use of a conventional clarifier. The effluent suspended solids concentration following clarification was $<$ 200 mg/L. (See also W89-12081)(Lantz-PTT)
W89-12085

APPLICATION OF THE UASB-REACTOR FOR ANAEROBIC TREATMENT OF PAPER AND BOARD MILL EFFLUENT.
Buhrmann-Tetterode N.V., Roermond (Netherlands). Wastewater Dept.
L. H. A. Habets, and J. H. Knelissen.
IN: Symposium on Environmental Technology and Management, 1988. Main Theme: Advanced Biological Wastewater Treatment. Technical Report No. LIR/08/88/313, August 30, 1988. p 73-877, 5 fig, 3 tab, 4 photos, 19 ref.

Descriptors: *Wastewater treatment, *Advanced wastewater treatment, *Anaerobic digestion, *Pulp and paper industry, *Pulp wastes, *Biological wastewater treatment, Sludge blanket, Sludge digestion, Sludge seeding, Activated sludge process, Upflow anaerobic sludge-blanket reactors, Chemical oxygen demand, Retention time, Pilot plants, Biogas, Performance evaluation, Investment, Economic aspects, Cost analysis.

Wastewater treatment is described at two Dutch paper and board mills which use mainly waste paper as raw material. In September 1981, research on anaerobic treatment using upflow anaerobic sludge-blanket (UASB) reactors was started. After good results had been achieved at a laboratory scale (30:1), further investigations were started on a semi-production scale (50 cu m). In both cases, loadings of up to 20 kg chemical oxygen demand (COD)/cu m/day could be handled after the anaerobic seed sludge became granulated. COD-removal was 70%, even when the hydraulic retention time was only 2.5 hrs. In April 1983, a 70 cu m practical UASB reactor was started up at the solid board mill of Ceres. In October 1983, a full scale plant was started up at Papierfabriek Roermond. This plant consists of 1,000 cu m UASB reactor and a 70 cu m gasholder. It is used for pretreatment of effluent, in order to reduce the loading of the activated sludge plant. Beside energy savings on the oxygen input, about 1 million cu m/yr of biogas is being generated and is used for steam production. Both plants are working satisfactorily. Investment costs appear to be relatively low. At Ceres, payback time is 1.5 year, while at Papierfabriek Roermond wastewater treatment is cheaper than before, although capacity if doubled. (See also W89-12081) (Author's abstract)
W89-12086

BIOLOGICAL TREATMENT OF METALWORKING WASTEWATERS.
General Motors Corp., Detroit, MI.
P. N. Mishra, and P. M. Sutton.
IN: Symposium on Environmental Technology and Management, 1988. Main Theme: Advanced Biological Wastewater Treatment. Technical Report No. LIR/08/88/313, August 30, 1988. p 89-106, 3 fig, 6 tab, 1 ref.

Descriptors: *Advanced wastewater treatment, *Wastewater treatment, *Biological wastewater treatment, *Metal-finishing wastes, Industrial wastewater, Synthetic coolants, Oily water, Pilot plants.

Major segments of the Metalworking Industry are converting from petroleum and oil-based coolants used for machining and hydraulic applications to synthetic (oil content 10% or less) and semisynthetic coolants (oil content 30% or less). The synthetics are based on water soluble organics such as polyglycols, glycol ethers, and alcohol amine salts. A major concern relating to the use of synthetic coolants for the industrial user is the incompatibility of the compounds with existing on-site wastewater treatment systems. The true synthetic coolants contain no petroleum oil, thus the organics are completely water soluble and normally cannot be separated from the water phase as can the oils by breaking the oil-water emulsion. Therefore, the conventional oily wastewater treatment system will not effect removal of the soluble organics and thus the plant effluent will contain significant levels of biochemical oxygen demand, chemical oxygen demand and organic nitrogen compounds. Depending on the site-specific industrial surcharge costs or direct discharge regulations, further on-site treatment may be warranted.

This paper discusses the application of the Oxitron biological fluidized system for treatment of metal-working fluids. The results of two pilot plant studies completed for General Motors' plants are presented. The results formed the basis of full-scale plant design for General Motors' plants in Ypsilanti and Lansing, Michigan, and Sandusky, Ohio. (See also W89-12081)(Author's abstract)
W89-12087

COUPLED BIOLOGICAL DOWNFLOW FLUID BED REACTOR TREATMENT OF SYNFUELS WASTEWATER.
North Dakota Univ., Grand Forks. Dept. of Civil Engineering.
C. D. Turner, C. S. Ong, and J. R. Gallagher.
IN: Symposium on Environmental Technology and Management, 1988. Main Theme: Advanced Biological Wastewater Treatment. Technical Report No. LIR/08/88/313, August 30, 1988. p 108-130, 11 fig, 1 tab, 10 ref. DOE Contract DE-FC21-86MC10637.

Descriptors: *Advanced wastewater treatment, *Chemical wastewater, *Biological wastewater treatment, *Fluidized bed process, *Synthetic fuels, *Wastewater treatment, Biological treatment, Denitrification, Nitrification, Hydrogen ion concentration, Nitrites, Nitrates, Dissolved oxygen, Biodegradation.

At the Great Plains Gasification Plant (GPGP), coupled biological fluidized bed system was used for both nitrifying and denitrifying synfuels wastewater (SGL), while removing biodegradable organics in the denitrification column. Successful operation of the process was dependent on pH control. This was especially important during system startup because the GPGP SGL pH varied from 8.0 to 8.6. At these pHs, unionized ammonia concentrations were often > 30 mg/L and created toxic conditions. Nitrification was established intermittently during the first three months of operation. Only after adding acid to initially lower the pH, and alkali in the 6.5 to 7.5 region was consistent, was nitrification possible. Denitrification was established quickly and was very stable as evidenced by the low nitrite and nitrate concentrations in the effluent. Dissolved oxygen concentrations must, however, be maintained at < 0.5 mg/L in the influent to the column. (See also W89-12081)(Lantz-PTT)
W89-12088

'NO SPACE' BIOLOGICAL WASTE WATER PROCESS: IT PACKS 1000 SQUARE FEET OF SURFACE INTO 1 CUBIC FOOT OF SPACE.
IN: Symposium on Environmental Technology and Management, 1988. Main Theme: Advanced Biological Wastewater Treatment. Technical Report No. LIR/08/88/313, August 30, 1988. p 132-159, 4 ref.

Descriptors: *Advanced wastewater treatment, *Biological wastewater treatment, *Wastewater treatment, *Fluidized bed process, Denitrification, Aerobic treatment, Case studies, Biochemical oxygen demand, Pilot plants, Nitrification.

The application of the fluidized bed process to the treatment of wastewater has been one of the significant advancements of environmental engineering technology. This concept provides for a very long biological solids retention time, in a short hydraulic retention time reactor. The attainment of these seemingly contradictory objectives is possible as a result of attachment of the microorganisms to an inert granular medium, which is maintained in the reactor. Initially, the process was developed for denitrification and was later extended for use in aerobic systems (both carbonaceous biochemical oxygen demand (BOD) reduction and nitrification). Full scale systems for nitrification (Dworshak National Fish Hatchery in Ahsahka, ID), denitrification (Pensacola, FL), and BOD removal (Nassau County, NY) are either in place or planned. The fluidized bed system, based on a number of successful pilot studies, appears ideal for application to the treatment of industrial wastewater by anaerobic organisms. In 1980, the Department of Energy (DOE), through a solicitation program, deemed the fluidized bed process to be worthy of providing demonstration funds to prove the commercial viability of the technology, but funds were subsequently withdrawn due to Federal budgetary constraints. (See also W89-12081) (Lantz-PTT)
W89-12089

DEVELOPMENT OF INNOVATIVE FLOTATION PROCESSES FOR WATER TREATMENT AND WASTEWATER RECLAMATION.
Krofta Engineering Corp., Lenox, MA.
M. Krofta, and L. K. Wang.
Available from the National Technical Information Service, Springfield, VA 22161, as PB89-102255. Price codes: A03 in paper copy, A01 in microfiche. Technical Report No. LIR/08-88/312, August 1, 1988. 41p, 9 fig, 1 tab.

Descriptors: *Wastewater renovation, *Flotation, *Water treatment, *Wastewater treatment, Design standards, Recycling, Waste recovery, Groundwater quality, Potable water, Separation techniques, Pulp wastes.

The engineering designs and applications of various newly developed flotation clarifiers (Supracell, Sandfloat, Sedifloat, Lakeguard, Float Skimmer, and Foamer) are presented. Supracell is a high-rate dissolved air flotation clarifier for industrial water treatment and in-plant water recycle. Sandfloat is a package water treatment plant designed for treatment of surface water, groundwater or wastewater. Sedifloat is a package plant from reclamation of process wastewater or pretreatment of raw water containing heavy silts and/or high concentrations of suspended solids. Lakeguard is an extremely compact package plant for single families, factories, and small institutions. Both lake water and groundwater can be properly treated by Lakeguard for potable applications and for treatment of septic tank effluent. Foamer is a high rate cost-effective dispersed air flotation clarifier. Float skimmer is specifically designed for applications in paper and pulp mills. (Author's abstract)
W89-12095

LABORATORY STUDIES OF METHODS FOR THE TREATMENT AND DISPOSAL OF THE WASTE STREAM FROM THE SILVER-RECOVERY FACILITY AT OAK RIDGE NATIONAL LABORATORY.
Oak Ridge National Lab., TN.
J. R. Parrott, and G. W. Strandberg.
Available from the National Technical Information Service, Springfield, VA 22161, as DE88-011703. Price codes: A03 in paper copy, A01 in microfiche. Report No. ORNL/TM-10682, May 1988. 15p, 1 fig, 3 tab, 3 ref. DOE Contract DE-AC05-84OR21400.

Descriptors: *Chemical wastewater, *Wastewater treatment, *Wastewater disposal, *Silver, *Oak Ridge National Laboratory, Waste recovery, Recycling, Activated carbon, Aeration, Ultraviolet radiation, Chemical precipitation, Chemical treatment, Toxicity, Water quality standards, Wastewater facilities, Iron, Oxygen demand, Oxidation.

A process has been developed at the Oak Ridge National Laboratory (ORNL) for recovering silver from spent photographic solutions. This process involves chemical precipitation of the silver using NaOH and sodium hydrosulfite as a reductant. The waste stream generated from the silver-recovery process is essentially free of silver but contains about 15 g/L sodium hydrosulfite, a variety of undetermined organics (about 100 mg/L), and other inorganic components. The use of activated carbon to remove these organics from photographic waste solutions does not appear to be an effective treatment option. Aeration of a chemically amended waste (e.g., with FeCl3) was effective in reducing the time required to remove the oxygen demand of the photowaste. However, the resulting waste solution has an iron content above discharge limits. Also, there was no change in toxicity. Ultraviolet light-aided oxidation with H2O2 was not effective in reducing the toxicity or oxygen demand of photowaste. The discharge of the photographic waste to ORNL's sewage treatment plant (STP) appears to be an effective means of treatment and disposal. At the projected rate of discharge (379 L/day), the waste had no effect on reactor performance as measured by TOC reduction, and there was no indication of acute biotoxicity. Reduction of the oxygen demand before treatment was not necessary, but it was not determined whether neutralization of the waste is required. The rate at which photographic waste is discharged to the STP must be controlled to ensure that its concentration does not reach toxic levels. (Lantz-PTT)
W89-12098

SCREENING OF STARCH ASSIMILABLE YEASTS USING VERMICELLI WASTEWATER AND THEIR TAXONOMIC CHARACTERISTICS.
Feng Chia Univ., Taichung (Taiwan).
T. L. Hu.
Available from the National Technical Information Service, Springfield, VA 22161, as PB89-104707. Price codes: E03 in paper copy, E03 in microfiche. 1986. 18p, 2 fig, 11 tab, 15 ref. National Science Council Grant NSC 75-0409-B035-01.

Descriptors: *Food-processing wastes, *Taxonomy, *Wastewater treatment, *Starch, *Yeasts, *Biological wastewater treatment, Chemical oxygen demand, Hydrogen ion concentration, Turbidity, Food processing industry, Culturing techniques.

117 soil samples were collected from the Feng Chia University campus, rice paddies, a vermicelli factory, and a grape orchard, for the isolation of yeasts, which were enriched by adding propionic acid (0.1%) to the growth broth. There were 391 acid tolerant starch assimilative yeasts isolated. From the results of starch utilization, protein hydrolysis and lactic acid (0.11M) tolerance, 10 strains were screened. These ten yeast strains also showed a strong ability for starch assimilation. Treatment of starchy wastewater discharged from the vermicelli factory using isolated yeasts by batch culture showed that chemical oxygen demand (COD) reduction was highest on the fourth day. Two strains could reduce 79-83% COD. The turbidity and pH of the treated wastewater increased after the fourth day. (Author's abstract)
W89-12113

WATER AND WASTEWATER SYSTEMS ANALYSIS.
University of the Witwatersrand, Johannesburg (South Africa). Water Systems Research Programme.
For primary bibliographic entry see Field 6A.
W89-12117

ENVIRONMENTAL POLLUTION CONTROL ALTERNATIVES: SLUDGE HANDLING, DEWATERING, AND DISPOSAL ALTERNATIVES FOR THE METAL FINISHING INDUSTRY.
Centec Corp., Reston, VA.
For primary bibliographic entry see Field 5E.
W89-12127

POLYCHLORINATED BIPHENYLS: OCCURRENCE AND TREATMENT IN MUNICIPAL AND INDUSTRIAL WASTES, JANUARY 1977-MAY 1988: CITATIONS FROM THE SELECTED WATER RESOURCES ABSTRACTS DATABASE.
National Technical Information Service, Springfield, VA.
Available from National Technical Information Service, Springfield, VA 22161 as PB88-865514, Price codes: N01 in paper copy, N01 in microfiche. June 1988. 59p. Supersedes PB87-856571.

Descriptors: *Wastewater treatment, *Bibliographies, *Industrial wastewater, *Municipal wastewater, *Polychlorinated biphenyls, Pollutant identification, Activated carbon, Incineration, Bio-

degradation, Legal aspects, Regulations, Hazardous wastes.

This bibliography contains citations concerning treatment and disposal methods, specific site studies, detection methods and equipment, and monitoring techniques for polychlorinated biphenyls in industrial and municipal wastes. Treatment methods include activated carbon, incineration, and biodegradation. Legal and regulatory aspects are also discussed. Reports pertaining specifically to the occurrence of these compounds in sediments and soils are excluded from this bibliography. This updated bibliography contain 148 citations of which 31 are new entries to the previous edition. (Author's abstract)
W89-12146

METALS RECOVERY FROM WASTES, JUNE 1970-APRIL 1988: CITATIONS FROM THE COMPENDEX DATABASE.
National Technical Information Service, Springfield, VA.
Available from National Technical Information Service, Springfield, VA 22161 as PB88-862115, Price codes: N01 in paper copy, N01 in microfiche. April 1988. 96p. Supersedes PB87-859658.

Descriptors: *Wastewater treatment, *Bibliographies, *Industrial wastewater, *Resource recovery, *Metals, Metal-finishing wastes, Recycling, Waste recovery.

This bibliography contains citations concerning the recovery and recycling or reuse of ferrous and nonferrous metals from various industrial wastes, especially wastewaters. This updated bibliography contains 334 citations of which 30 are new entries to the previous edition. (Author's abstract)
W89-12148

METALS RECOVERY FROM WASTES, JANUARY 1977-APRIL 1988: CITATIONS FROM THE SELECTED WATER RESOURCES ABSTRACTS DATABASE.
National Technical Information Service, Springfield, VA.
Available from National Technical Information Service, Springfield, VA 22161 as PB88-862008, Price codes: N01 in paper copy, N01 in microfiche. April 1988. 108p. Supersedes PB87-859427.

Descriptors: *Wastewater treatment, *Bibliographies, *Industrial wastewater, *Resource recovery, *Metals, Metal-finishing wastes, Recycling, Waste recovery.

This bibliography contains citations concerning the recovery and recycling or reuse of ferrous and nonferrous metals from various industrial wastes, especially waste waters. This updated bibliography contains 279 citations of which 35 are new entries to the previous edition. (Author's abstract)
W89-12149

WASTEWATER TREATMENT, JUNE 1976-MARCH 1988: CITATIONS FROM THE ENERGY DATA BASE.
National Technical Information Service, Springfield, VA.
Available from National Technical Information Service, Springfield, VA 22161 as PB88-860143, Price codes: N01 in paper copy, N01 in microfiche. March 1988. 112p. Supersedes PB86-867702.

Descriptors: *Wastewater treatment, *Bibliographies, *Industrial wastewater, Recycling, Waste recovery, Trace metals, Metals, Chemical wastewater.

This bibliography contains citations concerning techniques and equipment for treatment of industrial (except mining) effluent streams. Consideration is given to the removal, reclamation, and recycling of various trace metals, heavy-metals, hydrocarbons, and oily wastewaters to meet regulatory agency discharge or inplant reuse standards. This updated bibliography contains 369 citations of which 118 are new entries to the previous edition. (Author's abstract)
W89-12156

WASTEWATER TREATMENT: LAGOONS, JANUARY 1977-FEBRUARY 1988: CITATIONS FROM THE SELECTED WATER RESOURCES ABSTRACTS DATABASE.
National Technical Information Service, Springfield, VA.
Available from National Technical Information Service, Springfield, VA 22161 as PB88-858626, Price codes: N01 in paper copy, N01 in microfiche. March 1988. 112p. Supersedes PB86-867884.

Descriptors: *Wastewater treatment, *Bibliographies, *Wastewater lagoons, Industrial wastewater, Tannery wastes, Pulp wastes, Food-processing wastes.

This bibliography contains citations concerning the treatment and storage of wastewaters in lagoons. The design, operation, equipment, and pretreatment processes are discussed. The treatment of wastewater from breweries, tanneries, paper mills and other industrial operations are considered. Descriptions and evaluations of specific facilities are provided. This updated bibliography contains 294 citations of which 18 are new entries to the previous edition. (Author's abstract)
W89-12158

SEWAGE SLUDGE PRETREATMENT AND DISPOSAL, DECEMBER 1981-FEBRUARY 1988: CITATIONS FROM THE NTIS BIBLIOGRAPHIC DATABASE.
National Technical Information Service, Springfield, VA.
Available from National Technical Information Service, Springfield, VA 22161 as PB88-859509, Price codes: N01 in paper copy, N01 in microfiche. March 1988. 107p. Supersedes PB86-857398.

Descriptors: *Wastewater treatment, *Sludge disposal, *Bibliographies, Resource recovery, Land disposal, Composting, Ocean dumping, Incineration, Sludge digestion, Sludge drying, Disinfection.

This bibliography contains citations concerning techniques and equipment utilized in the pretreatment processes and disposal of sewage sludges. Topics include resource and energy recovery operations, land disposal, composting, ocean disposal, and incinerations. Digestion, dewatering, and disinfection are among the pretreatment processes discussed. Environmental aspects, including the effects on soils, plants, and animal are also presented. This updated bibliography contains 323 citations of which 74 are new entries to the previous edition. (Author's abstract)
W89-12159

WASTEWATER TREATMENT: OZONATION PROCESSES AND EQUIPMENT, JANUARY 1977-JULY 1988: CITATIONS FROM THE SELECTED WATER RESOURCES ABSTRACTS DATABASE.
National Technical Information Service, Springfield, VA.
Available from National Technical Information Service, Springfield, VA 22161 as PB88-867122, Price codes: N01 in paper copy, N01 in microfiche. August 1988. 99p. Supersedes PB87-866232.

Descriptors: *Wastewater treatment, *Bibliographies, *Ozonation, Disinfection, Water treatment, Municipal water, Chlorination, Industrial wastewater.

This bibliography contains citations concerning the utilization of ozonation processes for wastewater disinfection. Topics include system descriptions and evaluations, comparisons with the chlorination process, reaction kinetics, and the use of the process in combination with other wastewater treatment methods. The treatment of organic and inorganic compounds in wastewater and municipal water supplies is discussed. This updated bibliography contains 255 citations of which 27 are new entries to the previous edition. (Author's abstract)
W89-12164

SEWAGE AND INDUSTRIAL WASTE TREATMENT: WETLANDS, JANUARY 1977-JULY 1988: CITATIONS FROM THE SELECTED WATER RESOURCES ABSTRACTS DATABASE.
National Technical Information Service, Springfield, VA.
Available from National Technical Information Service, Springfield, VA 22161 as PB88-866470, Price codes: N01 in paper copy, N01 in microfiche. August 1988. 39p.

Descriptors: *Wastewater treatment, *Bibliographies, *Industrial wastewater, *Municipal wastewater, *Wetlands, Sludge, Nutrient removal, Heavy metals, Resource recovery, Aquaculture.

This bibliography contains 93 citations concerning developments, operations, and evaluations of natural and artificial wetlands treatment of wastewater and sludge. Aquaculture treatments of industrial, municipal, and domestic wastewater are examined. Topics include nutrient removal, heavy metal recovery, and case studies of wetlands being used for wastewater treatment. (Author's abstract)
W89-12165

POLYELECTROLYTES: WASTEWATER AND SEWAGE TREATMENT, JANUARY 1977-JUNE 1988: CITATIONS FROM THE SELECTED WATER RESOURCES ABSTRACTS DATABASE.
National Technical Information Service, Springfield, VA.
Available from National Technical Information Service, Springfield, VA 22161 as PB88-866579, Price codes: N01 in paper copy, N01 in microfiche. July 1988. 99p. Supersedes PB86-867694.

Descriptors: *Wastewater treatment, *Bibliographies, *Polyelectrolytes, *Water treatment, Flocculation, Coagulation, Pollutant identification, Sludge drying, Hospital wastewater.

This bibliography contains citations concerning polyelectrolytes in wastewater and water treatment. Topics include flocculation, coagulation, separation techniques, pollutant identification, water pollution sources, sludge dehydration, and descriptions of specific studies. Hospital wastewater processing, methods of synthesizing polyelectrolyte complexes, and performance evaluations of polyelectrolytes are discussed. This updated bibliography contains 257 citation of which 22 are new entries to the previous edition. (Author's abstract)
W89-12167

SLUDGE DEWATERING: SEWAGE AND INDUSTRIAL WASTES, JANUARY 1978-JANUARY 1988: CITATIONS FROM THE POLLUTION ABSTRACTS DATABASE.
National Technical Information Service, Springfield, VA.
For primary bibliographic entry see Field 5E.
W89-12168

5E. Ultimate Disposal Of Wastes

ENTERIC VIRUS: RISK ASSESSMENT OF OCEAN DISPOSAL OF SEWAGE SLUDGE.
Arizona Univ., Tucson. Dept. of Nutrition and Food Science.
For primary bibliographic entry see Field 5C.
W89-11073

MICROBIAL ECOSYSTEM IN PETROLEUM WASTE LAND TREATMENT,
University of Southern California, Los Angeles. Environmental Engineering Program.
For primary bibliographic entry see Field 5D.
W89-11109

EFFECT OF PETROCHEMICAL ACTIVATED SLUDGE ON SOIL PROPERTIES.
Universidade Federal do Rio Grande do Sul, Porto Alegre (Brazil).

M. Tedesco, M. Ligo, C. Gianello, and Z. Simon.
Water Science and Technology WSTED4, Vol. 20, No. 10, p 63-74, 1988. 4 fig, 6 tab, 13 ref.

Descriptors: *Waste disposal, *Chemical wastewater, *Activated sludge, *Soil properties, *Land disposal, *Wastewater treatment, Sludge disposal, Sludge utilization, Injection, Decomposition, Carbon, Nitrogen, Phosphorus, Fertilizers, Acidity, Metals, Heavy metals.

Excess activated sludge produced at SITEL, the integrated wastewater treatment plant of the South Petrochemical Complex in Brazil, is disposed of by subsurface injection on pangola grass fields at average application rates of 24 tons/year (dry basis). A growth-leaching pot experiment showed the following results. Sludge decomposition in soil amounted to 2.7% of carbon lost as CO2. Sludge application brought about an enrichment of soil C, N, and P restricted to the top layer; no significant modifications were observed in soil pH or in K, Ca, Mg, Fe, Mn, and B. Slight increases were observed in contents of Na, Cu, and S and electrical conductivity of the top layer. Appreciable increases were noted in soil contents of Zn, Cr, Cd, and Ni, in correlation with increasing sludge application rates. The resulting values, however, fell well below the tolerable limits. It is concluded that proper management of a sludge application system that reproduces the conditions chosen for this investigation can yield a useful site life of many years without appreciable environmental risks. (Doria-PTT)
W89-11225

BY-PRODUCTS FROM A PETROCHEMICAL EFFLUENT TREATMENT PLANT: THE CASE OF SITEL.
CORSAN-SITEL, Triunfo (Brazil).
Z. Simon, M. L. Baldasso, and T. R. M. Zoppas.
Water Science and Technology WSTED4, Vol. 20, No. 10, p 183-191, 1988. 3 fig, 1 tab, 7 ref.

Descriptors: *Chemical wastes, *SITEL, *Waste management, *Wastewater treatment, *Oil wastes, Brazil, Slurries, Scum, Waste characteristics, Waste disposal, Land disposal, Sludge, Metals, Regulations, Ditches.

Normal unit operations conducted at SITEL, the integrated wastewater treatment system of South Petrochemical Complex, Brazil, generate several by-products that must be handled separately: sludges, slurries, scums, garbage, grit, containers, etc. Some are hauled to the Centralized System of Control of Solid Residues (SICECORS); others are disposed of within SITEL battery limits. The origin, production, chemical constitution, and final destination of the by-products are discussed, and provides a detailed comparison between the main residues is presented. A revision of the current classification criteria is proposed. Under new criteria, combined disposal by subsurface injection in the existing sludge farm area might be technically acceptable and endorsed by the environmental authority. Oily wastes would probably be an exception, due to their physical properties and high contents of oil and solids. Any decision, however, would have to be based on results obtained after a thorough and specific monitoring program. (Author's abstract)
W89-11236

SOLID WASTE MANAGEMENT: RECOVERY OF ENERGY AND USEFUL MATERIALS.
National Univ. of Singapore. Dept. of Civil Engineering.
M. A. Aziz.
Water Science and Technology WSTED4, Vol. 20, No. 10, p 211-220, 1988. 2 fig, 11 tab, 17 ref.

Descriptors: *Waste recovery, *Energy, *Solid wastes, *Construction materials, *Waste management, Singapore, Economic aspects, Waste characteristics, Anaerobic digestion, Incineration, Chemical composition, Sludge, Concretes.

The salient features of solid waste management systems for producing energy and useful building materials are highlighted, with special reference to Singapore and other Southeast Asian countries. Technologies for the production of energy and useful materials from solid waste fall under two major categories, thermal processes and bioconversion processes. Thermal processes include direct combustion and pyrolysis. Incineration is a proven method of disposing of solid wastes with considerable resource recovery. Bioconversion processes include composting, biological hydrolysis, anaerobic decomposition or digestion, and sanitary landfilling. Anaerobic digestion has proven to be effective and economically advantageous for producing energy (e.g., alcohols, methane gas) and other useful materials. Waste management decisions should be based on sound judgment, judicious organizational and administrative infrastructures, objective technologies with a view to recover energy and useful materials, appropriate standards and design criteria, and cost-benefit ratio in order to make waste disposal safe, efficient, economically attractive, and environmentally acceptable. (Doria-PTT)
W89-11239

LANDFARMING FOR TREATMENT AND DISPOSAL OF OILY WASTES ORIGINATING IN THE SOUTH PETROCHEMICAL COMPLEX.
Companhia Petroquimica do Sul, Triunfo (Brazil).
C. M. P. Rangel, J. H. Frantz, and M. Bastiani.
Water Science and Technology WSTED4, Vol. 20, No. 10, p 221-230, 1988. 2 fig, 4 tab, 11 ref.

Descriptors: *Wastewater treatment, *Wastewater disposal, *Land disposal, *Sludge disposal, *Oil wastes, *Chemical wastewater, Biodegradation, Brazil, SITEL, Waste storage, Monitoring, Groundwater, Leachates, Water quality, Costs, Economic aspects.

COPESUL (Companhia Petroquimica do Sul, Brazil) has recently implemented a land farming system for the disposal of oily sludges. The site was divided into six parallel cells provided with internal roads to allow the easy access of equipment. The cells were made impermeable by means of a structure composed, from bottom to top, of: a layer of unsaturated natural clay with a minimum thickness of 3.60 m (with the top 15 cm compacted); a draining ballast, for safety purposes, which collects the liquid if this percolates through the top impermeable layer; an impermeable layer with a minimum thickness of 50 cm, obtained by compaction of the local clay; and a reactive layer, properly prepared to receive the sludge. The system is also provided with tanks to receive the waste to be treated and for storage of rainwater leachate which is collected and transported to SITEL (Integrated System for Treatment of Liquid Effluents) for treatment. Furthermore, a storage area for drums is provided for wastes delivered in this form. In addition to data on the project, the paper also gives details of the characteristics of the wastes, the monitoring plan, investment costs, and operating data. (Author's abstract)
W89-11240

DEVELOPMENT OF ASSESSMENT TECHNIQUES TO EVALUATE THE BIODEGRADATION OF OILY SLUDGE IN A LANDFARMING SYSTEM,
Gujarat Narmada Valley Fertilizers Co. Ltd., Broach (India).
D. C. P. Casarini, R. M. de Macedo, R. C. A. Cunha, and J. C. O. Mauger.
Water Science and Technology WSTED4, Vol. 20, No. 10, p 231-236, 1988. 1 fig, 6 tab, 14 ref.

Descriptors: *Biodegradation, *Oil wastes, *Sludge disposal, *Land disposal, Activated sludge process, Oil refineries, Soil chemistry, Soil properties, Nutrients, Hydrogen ion concentration, Hydrocarbons, Optimization, Leaching, Groundwater, Water quality, Carbon dioxide, Soil bacteria, Soil fungi.

A respirometer assay was developed with the intention of defining a standard methodology to identify the major mechanisms related to biodegradation of oily sludge in a landfarming system. The oily sludge is characterized as a biological sludge produced in an activated sludge wastewater treatment plant which treats industrial and domestic wastewater from a petroleum refinery. The effect of soil pH control, nutrient balance, and sludge application rates were investigated. It was concluded that the methodology is acceptable as a procedure to qualify waste for land treatment. The soil with pH control (pH about 7.0) was shown to be more effective in oily sludge biodegradation than without pH control. Under these experimental conditions, the best application rate for the oily sludge on soil was 1% (w/w) of its hydrocarbon content. Soil pH control, sludge nutrient balance, and sludge application rate are all of importance to optimize the system, to avoid leaching, and to protect the groundwater. The landfarming system has been used by several refineries. (Author's abstract)
W89-11241

HANDLING AND PROCESSING OF SOLID WASTE AT GNFC-AN APPROACH TO ZERO SOLID WASTE.
Gujarat Narmada Valley Fertilizers Co. Ltd., Broach (India).
V. K. Karia, and Z. S. Sadliwala.
Water Science and Technology WSTED4, Vol. 20, No. 10, p 237-242, 1988.

Descriptors: *Solid wastes, *India, *Waste management, *Waste recovery, Carbon, Lime, Catalysts, Sludge, Construction materials, Concretes, Crop production, Waste storage.

Gujarat Narmada Valley Fertilizers Company Limited (GNFC), located in a backward District of Bharuch in Gujarat State, India, owns the world's largest single stream ammonia and urea plants. GNFC uses 1000 MT of oil and 1000 MT of coal daily as raw material and generates huge quantities of solid wastes like fly ash, carbon soot, lime sludge, hard coke, and spent catalysts. For management of these solid wastes, GNFC has adopted a productivity oriented approach. A number of research and development oriented projects were undertaken as a result of which most of the solid wastes could be put to productive use. GNFC is on the verge of achieving a state of zero solid waste. (Author's abstract)
W89-11242

DISPOSAL OF NUCLEAR WASTE: A PROBLEM IN MASS MANAGEMENT,
Texas A and M Univ., College Station. Dept. of Geology.
P. A. Domenico, A. Lerman, and J. W. Bartlett.
Ground Water GRWAAR, Vol. 27, No. 3, p 363-374, May-June 1989. 1 fig, 3 tab, 10 ref, append.

Descriptors: *Radioactive wastes, *Radioactive waste disposal, *Environmental policy, *Environmental protection, Groundwater pollution, Groundwater barriers, Groundwater movement.

A reference repository is examined for environmental compliance utilizing minimum performance standards as established by the Nuclear Regulatory Commission and the Environmental Protection Agency. These standards stipulate the amount of time the radionuclides must be retained in the barrier, the acceptable release rates from the barrier, and the acceptable mass release that can be registered at the accessible environment over a 10,000-yr time frame. The only natural, or geologic barrier standard specified is a minimum groundwater travel time of 1000 years from the engineered barrier to the accessible environment. Other natural barrier processes including geochemical retardation and mass transfer, dilution, and dispersion are not specified. In attempting to determine the role that these unspecified components must play in order to comply with the mass release standard, we find that their role is minimal to the extent that virtually any rock type that can satisfy the minimum groundwater travel time of 1000 years will satisfy the mass release requirements at the accessible environment. Full compliance with a concentration standard at the accessible environment requires that the nuclides contained within the larger inventories be fully contained with the controlled zone between the engi-

neered barrier and the accessible environment. (Author's abstract)
W89-11279

SYSTEM FOR ON SITE TREATMENT AND DISPOSAL OF WASTEWATERS FROM TOURIST RESORTS,
National Technical Univ., Athens (Greece). Dept. of Civil Engineering.
For primary bibliographic entry see Field 5D.
W89-11349

CURRENT U.K. RESEARCH INTO THE DESIGN AND OPERATION OF LONG SEA OUTFALLS.
WRC Engineering, Swindon (England).
For primary bibliographic entry see Field 5D.
W89-11350

WASTEWATER TREATMENT AND DISPOSAL IN THE CITY OF DUBROVNIK.
Split Univ. (Yugoslavia). Faculty of Civil Engineering Sciences.
For primary bibliographic entry see Field 5D.
W89-11351

SEWAGE TREATMENT AND DISPOSAL PROBLEM IN CYPRUS IN THE ABSENCE OF SEWERAGE SYSTEMS: LIMASSOL CASE STUDY--EVALUATION OF COMPROMISE SOLUTIONS,
Ministry of the Interior, Limassol (Cyprus). Dept. of Town Planning and Housing.
For primary bibliographic entry see Field 5D.
W89-11353

IMPACT OF WASTE DISCHARGES ON CORAL REEF REGIONS,
Queensland Univ., Brisbane (Australia). Dept. of Chemical Engineering.
For primary bibliographic entry see Field 5C.
W89-11359

SEA DISPOSAL: MODELLING STUDIES OF WASTE FIELD DILUTION.
Imperial Chemical Industries Ltd., Brixham (England). Brixham Lab.
R. E. Lewis, and A. M. Riddle.
Marine Pollution Bulletin MPNBAZ, Vol. 20, No. 3, p 124-129, March 1989. 4 fig, 4 tab, 16 ref.

Descriptors: *Wastewater dilution, *Ocean dumping, *Outfall, *Wastewater disposal, *Mathematical models, Effluents, Toxicity, Seawater.

Mathematical models have been set up to describe the dispersing plume formed when liquid effluent is discharged to a ship's wake and the subsequent dilution of the waste field after it has spread over the disposal area. Comparisons were made between the dilution obtainable at the disposal site off the River Tees with that of a site off the Humber. On the basis of the rather limited oceanographic data available, the models indicate that the waste would mix throughout depth more quickly at the Humber site than at the Tees, but the shallowness of the water at the Humber would limit the rate of subsequent dilution. Within 48 h of the waste becoming spread over the disposal area, the dilution at the Humber ground was predicted to 2200000 times; in the same period, the waste discharged off the Tees would be 9700000 times dilution. Under the stratified conditions which can occur at the Tees disposal area in summer, the estimated dilution would be reduced to 3700000 times. With steady and relatively weak residual currents, it was predicted that diluted effluent would not be completely clearer from either disposal area in the 2-3 days between successive discharges. However, the estimated dilution of the effluent in this interval is several orders higher than concentrations known to be toxic to sensitive marine species and stronger residual flows than those assumed are known to occur intermittently, so that significant build-up is unlikely and the waste would not have any long-term adverse effects on marine life. (Author's abstract)
W89-11385

IDENTIFICATION AND QUANTIFICATION OF P-CHLOROBENZENESULFONIC ACID IN GROUNDWATER.
National Enforcement Investigations Center, Denver, CO.
For primary bibliographic entry see Field 5A.
W89-11404

BIOTOP IMPAIRMENT CAUSED BY POTASSIUM POLLUTED WATER OF THE WERRA AND OBERWESER RIVERS (SCHADWIRKUNG DER KALI-ABWESSER IM BIOTOP DER WERRA UND OBERWESER),
For primary bibliographic entry see Field 5C.
W89-11432

PRELIMINARY HYDROGEOLOGIC EVALUATION OF THE CINCINNATI ARCH REGION FOR UNDERGROUND HIGH-LEVEL RADIOACTIVE WASTE DISPOSAL, INDIANA, KENTUCKY, AND OHIO.
Geological Survey, Raleigh, NC. Water Resources Div.
For primary bibliographic entry see Field 2F.
W89-11479

INCUBATION STUDIES OF THE FATE OF ORGANIC NITROGEN IN SOILS AMENDED WITH ACTIVATED SLUDGE.
Volcani Inst. of Agricultural Research, Bet-Dagan (Israel). Inst. of Soil and Water.
P. Fine, U. Mingelgrin, and A. Feigin.
Soil Science Society of America Journal SSSJD4, Vol. 53, No. 2, p 444-450, March/April 1989. 4 fig, 5 tab, 25 ref. Israel National Council for Research and Development Research Grant WT 222.

Descriptors: *Soil amendments, *Nitrogen compounds, *Sludge utilization, *Soil chemistry, *Activated sludge, Organic wastes, Soil physical properties, Soil organic matter, Sludge, Ammonia, Nitrification, Clays, Sand, Soil solution, Organic compounds, Incubation.

Mineralization of sludge organic N and the effect of transformations in nitrogen compounds on soil solution composition were studied in incubated soil-sludge mixtures. Four soils were incubated with sludge at four mixing ratios (1-15 percent sludge) for 90 d at 35 C under continuous flow of water saturated air. Soil-water contents were maintained at 60 percent of the 0.033 MPa tension. The extent of ammonification was 41 to 61 percent of the amount of sludge organic N added. Both soil properties and sludge content affected the extent of ammonification. The soils' effect was relatively small. Only the clayey and sandy soils differed significantly (54.5 vs. 47.9 percent). The effect of sludge loading was more pronounced. At 1 and 5 percent sludge contents, the ammonification was significantly greater (53 and 56 percent ammonified) than at 10 percent (48 percent) or 15 percent (43 percent) sludge contents. The reduced ammonification at the higher sludge and clay content might be related to the more intense nitrification-induced salinization observed in these treatments. Sludge content and soil properties affected the initial rates of both ammonification and ammonia volatilization. Ammonification was linearly related to sludge and clay content, whereas the volatilization rate was similarly related to sludge content but inversely related to cation exchange capacity (CEC). Estimated half-lives for the added organic N is 2 to 8.5 d. Up to 87 percent of the ammonified sludge N was lost as gaseous species, mostly as ammonia. Sludge application to soils and subsequent transformations could greatly influence soil solution chemistry and composition of exchangeable cations, depending mainly on its content. (Author's abstract)
W89-11574

STUDY OF SEWAGE SLUDGE TREATMENT BY MEIOBENTHOS, NITOCRA SP. AND MACROBENTHOS, NEANTHES JAPONICA (IZUKA).
Tohoku Univ., Sendai (Japan). Biological Inst.
For primary bibliographic entry see Field 5D.
W89-11584

SCENARIOS FOR REPOSITORY SAFETY ANALYSIS.
Disposal Safety, Inc., Washington, DC.
B. Ross.
Engineering Geology EGGOAO, Vol. 26, No. 4, p 285-299, April 1989. 2 fig, 2 tab, 31 ref.

Descriptors: *Safety, *Performance evaluation, *Waste disposal, Probabilistic process, Simulation analysis, Decision making, Data processing, Data interpretation, Model studies, Numerical analysis.

Three different approaches have been proposed to identify scenarios for performance assessments of high-level waste repositories: simulation, event trees, and judgment. Simulation models require large amounts of hard-to-obtain input data. Event trees tend to produce extremely large numbers of scenarios. Most published performance assessments rely on judgmental methods to choose scenarios. Whatever technique is used to identify scenarios, severe difficulties are encountered in assigning numerical probabilities to them. (Author's abstract)
W89-11588

GEOCHEMICAL ENVIRONMENT,
Virginia Univ., Charlottesville. Dept. of Environmental Sciences.
J. S. Herman.
Engineering Geology EGGOAO, Vol. 26, No. 4, p 301-317, April 1989. 65 ref.

Descriptors: *Underground waste disposal, *Waste disposal, *Radioactive wastes, *Geochemistry, Chemical properties, Model studies, Groundwater management, Soil contamination, Solubility, Mass transfer, Adsorption, Kinetics, Thermodynamics, Simulation analysis, Sensitivity analysis.

Much of the assessment of high-level radioactive waste repositories will be accomplished through the application of geochemical models. Such models will be used to understand geochemical processes in the repository and the surrounding environment. The nature of currently available geochemical models is reviewed. The kinds of calculations that a number of these models perform include aqueous speciation, mineral solubility, and mass transfer reactions. Presently, there are limitations on the success of calculation of adsorption reactions and rate-limited reactions. Ongoing development of geochemical models requires that more work be done to compile thermodynamic and kinetic data, incorporate additional geochemical processes and parameters into existing codes, and assess the accuracy of all simulations through validation studies and sensitivity analyses. (Author's abstract)
W89-11589

RADIATION EFFECTS ON CHEMISTRY.
Battelle Pacific Northwest Labs., Richland, WA.
R. J. Serne.
Engineering Geology EGGOAO, Vol. 26, No. 4, p 319-329, April 1989. 1 tab, 58 ref.

Descriptors: *Underground waste disposal, *Geochemistry, *Water pollution sources, *Radioactivity effects, *Waste disposal, *Groundwater, *Waste management, *Landfills, Solutes, Saline water, Closed systems, Hydrogen ion concentration, Oxidation-reduction potential, Temperature, Pressure, Rock properties, Chemical degradation, Chemical analysis, Leachates, Clays, Heat, Irradiation, Corrosion, Acidity, Simulation analysis.

The effects of ionizing radiation on simple solution systems have been studied by computer simulations of radiolysis in salt brine and dilute groundwater. The codes assume a closed homogeneous solution system in which reactants and products cannot enter or leave the system and species cannot diffuse towards or away from the source of radiation. Radiolysis of simple dilute groundwaters appears to be rather insensitive to the expected range of pH, temperature, and pressure in repositories. It is unclear whether this conclusion also holds for salt brine. The waste-package environment is much more complex than systems that have typically been studied in the past. None of the conceptual

models account for potential interactions with the solids present in the waste-package and host rocks. This limitation results primarily from a lack of data and the current restriction to homogeneous (solution only) reactions. Because the rocks and waste-package materials are the primary pH, Eh, and chemical buffers in the system, radiolysis experiments that neglect their presence cannot definitively address the expected influence of radiation on solution chemistry. Experimental evidence suggests that radiolysis will not cause significant changes in waste-form leaching, or significant degradation in the physical stability of clays, crystalline host rock, and packing materials. However, experiments in salt suggest that irradiation and heat could produce corrosive species that might affect canister corrosion and waste-form leaching. The possibility of enhanced container corrosion resulting from nitric acid formation in the moist air of an unsaturated tuff repository also warrants attention. (Author's abstract)
W89-11590

SUBSURFACE TRANSPORT IN WATER AND GAS.
Disposal Safety, Inc., Washington, DC.
For primary bibliographic entry see Field 5B.
W89-11591

NATURAL ANALOGUES.
Disposal Safety, Inc., Washington, DC.
S. Amter.
Engineering Geology EGGOAO, Vol. 26, No. 4, p 431-440, April 1989. 38 ref.

Descriptors: *Analog models, *Waste disposal, *Path of pollutants, *Underground waste disposal, *Environmental engineering, Geologic formations, Geologic control, Radioactive wastes, Landfills, Backfill, Sealants, Performance evaluation.

Natural analogs, which are occurrences of materials or processes which are analogous to expected materials or processes in a waste repository, are used to clarify the ability of the geologic environment and engineered system to contain the waste. It is hoped that natural analogs can provide data and insight on processes which generally occur on temporal or geometric scales which are too large to be studied in laboratory or field experiments. Natural analogs have been described for the study of transport and migration of radionuclides through the backfill and host rock, and the stability of backfill, shaft seals, waste forms, and waste containers. Natural analogs have also been suggested as an aid in predicting overall repository performance. (Author's abstract)
W89-11592

COMPARISON OF AN INDEX FUNCTION AND A VECTORIAL APPROACH METHOD FOR RANKING WASTE DISPOSAL SITES.
National Water Research Inst., Burlington (Ontario). Lakes Research Branch.
E. Halfon.
Environmental Science and Technology ESTHAG, Vol. 23, No. 5, p 600-609, May 1989. 5 fig, 4 tab, 21 ref.

Descriptors: *Risk assessment, *Environmental protection, *Waste disposal, *Project planning, Indexing, Ranking, Environmental effects, Hasse diagrams, Data processing, Costs, Classification.

A ranking method, which avoids the use of indexes, is applied to the classification and ranking of 38 waste disposal sites in the Detroit, St. Clair, and St. Mary's River areas. The ranking method is based on the hypothesis that a set of measurements is generally necessary to create a ranking file. These measurements can be considered the elements of a vector, the 'vector performance', which identifies the environmental hazard of each site. This method performs several functions: (a) It ranks toxic contaminants according to many criteria, tests, or attributes either in their original form, divided into classes, or with assigned weights. The ranking is displayed with Hasse diagrams, a useful tool adapted from lattice theory. (b) It identifies contradictions in the ranking according to each criterion. If many criteria are used, the number of contradictions increases. The ranking method analyzes all criteria and it shows graphically the presence of contradictions. The user can then analyze the raw data to understand how the ranking is obtained and why contradictions in the criteria exist. This contradictory evidence is usually lost in large spreadsheets with thousands of numbers. (c) The ranking system identifies which criteria are the most critical for ranking purposes. This information is important when some criteria contain redundant information, information that is expensive to collect in terms of dollars, time, and manpower. (White-Reimer-PTT)
W89-11623

FOREST MANAGEMENT: TREES RESPONSE TO WASTEWATER SLUDGE FERTILIZATION.
Institut National de la Recherche Scientifique, Sainte-Foy (Quebec).
D. Couillard, and Y. Grenier.
Journal of Environmental Management JEVMAW, Vol. 28, No. 3, p 235-242, April 1989. 2 tab, 32 ref. Natural Sciences and Engineering Research Council of Canada Grant A-3711.

Descriptors: *Forest management, *Plant growth, *Sludge disposal, *Sludge utilization, *Fertilizers, *Trees, Forests, Larch, Nitrogen, Pathogens, Heavy metals, Synthetic compounds, Risks, Hazards, Sludge stabilization, Ecological effects, Recycling.

A greenhouse study was conducted to evaluate the potential of wastewater sludge as a fertilizer for larch (Larix larcina) seedlings growing on sand. At the end of the experiment seedlings which received the greatest quantities of sludge had the best growth results. The treatment consisting of 425 kg N/ha as 17 applications of 25 kg N/ha presented the best yield. Compared to the control, the results of this treatment were superior by 350% for height, 210% for diameter, 375% for root biomass and 1140% for stem biomass. Even the treatment with a single 25 kg N/ha application displayed better yields than the control. Many studies have demonstrated that potential hazards associated with the utilization of wastewater sludge (pathogenic organisms, heavy metals, and synthetic compounds) are not of major importance in sludge utilization if the sludge is to be used in the production of ligneous matter. However, the sludge must be stabilized and must not contain high concentrations of these undesirable substances. These studies have not taken into consideration the forest ecosystem as a whole. Therefore, nothing can be advanced about possible changes occurring to its fungi, bacteria, insect, and bird populations. However, because wastewater sludge must be disposed of somewhere, it seems logical to develop these possibilities for its recycling. (White-Reimer-PTT)
W89-11627

WETTING FRONT INSTABILITY: 1. THEORETICAL DISCUSSION AND DIMENSIONAL ANALYSIS.
New York State Coll. of Agriculture and Life Sciences, Ithaca. Dept. of Agricultural and Biological Engineering.
For primary bibliographic entry see Field 2G.
W89-11760

WETTING FRONT INSTABILITY: 2. EXPERIMENTAL DETERMINATION OF RELATIONSHIPS BETWEEN SYSTEM PARAMETERS AND TWO-DIMENSIONAL UNSTABLE FLOW FIELD BEHAVIOR IN INITIALLY DRY POROUS MEDIA.
New York State Coll. of Agriculture and Life Sciences, Ithaca. Dept. of Agricultural and Biological Engineering.
For primary bibliographic entry see Field 2G.
W89-11761

SOME THEORETICAL AND FIELD ASPECTS OF REINJECTION IN GEOTHERMAL RESERVOIRS.
California Univ., Berkeley. Earth Sciences Div.
G. S. Bodvarsson, and V. Stefansson.
Water Resources Research WRERAO, Vol. 25, No. 6, p 1235-1248, June 1989. 21 fig, 2 tab, 52 ref. U.S. DOE Contract DE-AC03-76SF00098.

Descriptors: *Injection wells, *Geothermal resources, *Geothermal studies, Theory, Underground waste disposal, Temperature, Geologic fractures, Heat transfer.

Theoretical and field aspects of reinjection into geothermal reservoirs are discussed using examples from various geothermal fields. Reinjection effects can be observed in terms of pressure maintenance, changes in chemical concentrations, and temperature decline. Pressure support due to injection is observed in many liquid-dominated fields, and in two-phase field pressure, effects are often felt through mobility changes. In most geothermal fields where injection is employed, changes in chemical concentrations of the produced fluids have been observed, due to the higher salinity of the injected fluids. In some cases the returns of the injected fields observed through chemical changes have resulted in temperature declines in the producing wells. In those cases the fluid flow probably is concentrated through a few fractures or faults with insufficient surface area for heat exchange with the host rock. (Author's abstract)
W89-11765

APPROXIMATE SOLUTION FOR ONE-DIMENSIONAL ABSORPTION IN UNSATURATED POROUS MEDIA.
California Univ., Berkeley. Earth Sciences Div.
For primary bibliographic entry see Field 2G.
W89-11781

WATER BALANCE AT A LOW-LEVEL RADIOACTIVE-WASTE DISPOSAL SITE.
Geological Survey, Denver, CO. Water Resources Div.
For primary bibliographic entry see Field 2A.
W89-11801

TOXICITY OF ALUM SLUDGE TO CERIODAPHNIA DUBIA AND PIMEPHALES.
Johns Hopkins Univ., Shady Side, MD. Aquatic Ecology Section.
For primary bibliographic entry see Field 5C.
W89-11816

LONDON DUMPING CONVENTION--ITS DEVELOPMENT AND SIGNIFICANCE TO MARINE POLLUTION CONTROL.
Scientific Group on Dumping of the London Dumping Convention, Irish Science and Technology Agency, Shannon, Ireland.
R. G. V. Boelens.
IN: Canadian Conference on Marine Environmental Quality: Proceedings, February 29-March 3, 1988, Halifax, Nova Scotia. The International Institute for Transportation and Ocean Policy Studies, 1236 Henry St., Halifax, Nova Scotia, Canada. 1988. p 35-45, 1 fig, 3 tab, 1 ref.

Descriptors: *International agreements, *Ocean dumping, *London Dumping Convention, *Marine environment, *Water pollution control, Water pollution prevention, Standards, Waste disposal, Incineration, Waste management, Public policy.

Fifteen years after the establishment of the London Dumping Convention (LDC), this global agreement on the prevention of marine pollution is entering a new and important phase. Through the introduction of international procedures for regulating the disposal and incineration of wastes at sea, and the adoption of scientific guidelines by which marine pollution may be assessed and controlled, the LDC has effectively guided national administrations toward more judicious use of these disposal methods. To many, the record of the Convention endorses its continuing role in the prevention of marine pollution by wastes as well as an expanded role in the management of wastes. But for this to occur, change will be necessary. The perceptions and policies of individual states with respect to the marine environment vary widely, to some

extent influenced by divergent scientific opinion. The integration of national and international measures for protecting the oceans is imperative. Effective measures against marine pollution by wastes require commitment in practice as well as in principle, but they must also allow for economic, social and geographical differences. As far as the member states of LDC are concerned, the common denominator should be clearly defined and measurable goals for marine environmental quality. From the scientific viewpoint, such goals should be linked to an holistic concept of waste management. (See also W89-11852) (Author's abstract)
W89-11854

BOSTON HARBOUR: PAST PROBLEMS AND FUTURE SOLUTIONS.
Environmental Protection Agency, Boston, MA. Region I.
R. Kotelly.
IN: Canadian Conference on Marine Environmental Quality: Proceedings, February 29-March 3, 1988, Halifax, Nova Scotia. The International Institute for Transportation and Ocean Policy Studies, 1236 Henry St., Halifax, Nova Scotia, Canada. 1988. p 155-171, 6 fig, 7 tab.

Descriptors: *Harbors, *Waste disposal, *Wastewater outfall, *Boston Harbor, *Water pollution effects, *Water quality management, *Management planning, Sludge disposal, Wastewater disposal, Economic aspects, Costs, Social costs.

Boston Harbor is one of New England's greatest resources. It is economically important to the region, supporting transportation, shipping, fishing and shellfish harvesting. It is a valuable recreational resource, providing boating, swimming and island visitations. The resource has been significantly affected because of the continuous discharge of sludge and partially treated sewage over the past several decades. To correct this problem will take the will and energy of institutions at all levels of government--local, state and federal--as well as the overall support of the federal court system. Estimated costs of correction are close to three billion dollars. The majority of these costs will be borne by the ratepayers in the Massachusetts Water Resource Authority system. Questions are being raised as to the necessity of clean up by those bearing the costs. Similar questions are raised to the 'costs' of not cleaning up the harbor. (See also W89-11852) (Author's abstract)
W89-11860

ENVIRONMENTAL ASSESSMENT OF REMEDIAL ACTION AT THE RIVERTON URANIUM MILL TAILINGS SITE, RIVERTON, WYOMING. VOLUME I: TEXT.
Environmental Monitoring and Support Lab.-Cincinnati, OH. Biological Methods Branch.
For primary bibliographic entry see Field 4C.
W89-11880

SOIL ABSORPTION OF SEPTIC TANK EFFLUENT: A FIELD STUDY OF SOME MAJOR SOILS IN WISCONSIN.
Wisconsin Geological and Natural History Survey, Madison.
J. Bouma, W. A. Ziebell, W. G. Walker, P. G. Olcott, and E. McCoy.
University of Wisconsin-Extension Information Circular No. 20, 1972. 235p, 87 fig, 49 tab, 16 photos, 77 ref.

Descriptors: *Septic tanks, *Soil properties, *Wisconsin, *Land disposal, *Soil absorption capacity, *Wastewater disposal, *Path of pollutants, Saturated soils, Percolation, Sand, Permeability, Groundwater movement, Loam, Mounds, Soil physical properties, Performance evaluation, Effluent seepage, Ponding.

Soil disposal of septic tank effluent was studied in 20 systems in 12 major types of soil in Wisconsin. Processes of soil absorption of effluent from gravel-filled seepage beds and of groundwater flow were characterized by physical and hydrologic methods. Ponding of effluent was observed in seepage beds over 9 months old, in the entire range of soils, including the most permeable, at the same time that the surrounding soil remained unsaturated. This phenomenon apparently results from the presence of hydraulically resistant crusts a few centimeters thick at the interface between the seepage bed and the surrounding soil. The effect of such crusts is to reduce the hydraulic head of the ponded effluent, thereby allowing unsaturated conditions to persist in the soil below the bed, and reducing infiltration rates 20 to 100-fold, as compared with those into uncrusted, saturated soil. Three types of disposal systems could be distinguished in the different soils: (1) systems with a crusted seepage bed surrounded by highly permeable sand; (2) systems with a severely crusted seepage bed surrounded by permeable loamy soil materials; and (3) systems that did not function for a variety of conditions, other than severe crusting, such as: (1) the soil surrounding the seepage bed had a low permeability that did not allow adequate absorption of effluent even in uncrusted soil; (2) bedrock, either creviced or massive, was too close to the soil surface to allow construction of a subsurface seepage bed; or (3) a seasonally very high groundwater table flooded the subsurface seepage bed and made it ineffective in the Humbird sandy loam. An alternative to a conventional subsurface seepage bed in these areas is the 'mound system', consisting of a seepage bed built inside a mound of sandy soil fill material on top of the original soil surface. Soil physical data were used to calculate required dimensions of mounds for different soils. Monitoring results indicated that some systems worked well. (Lantz-PTT)
W89-11884

ENVIRONMENTAL ASSESSMENT OF SUBSURFACE DISPOSAL OF MUNICIPAL WASTEWATER TREATMENT SLUDGE: INTERIM REPORT.
R. Lofy.
1977. 112p, 18 fig, 19 tab, 61 ref, 4 append. EPA Contract 68-01-3108.

Descriptors: *Underground waste disposal, *Municipal wastewater, *Wastewater treatment, *Sludge disposal, *Environmental effects, *Water pollution effects, Site selection, Climatology, Geohydrology, Sludge, Groundwater pollution, Sampling, Water analysis, Administrative agencies, Case studies.

The disposal of municipal wastewater treatment plant sludge is a growing problem in the United States. Communities throughout the country are experimenting with various procedures for the disposal of sludge in an attempt to evolve a method best suited to their requirements. Regulatory agencies overseeing wastewater treatment and solid waste disposal in 48 states were contacted for information concerning wastewater treatment sludge disposal facilities in their respective states. Leads and recommendations from these agencies, as well as other sources, led to a preliminary investigation of over 300 such facilities in the U.S. An organized program has been developed by the US Environmental Protection Agency (EPA), Office of Solid Waste, to assess costs and the environmental impacts of different methods of sludge utilization and/or disposal. EPA awarded a contract in December 1974 to conduct an initial assessment of the environmental impacts of wastewater treatment sludge burial practices. Other features to be assessed included the economics, operation and aesthetics of such practices. This study was conducted through January 1976. This report discusses the project execution and data trends of the initial study and has been organized into the following topic areas: identification of site selection criteria; discussion of case study site selection process employed; brief description of the individual case study sites highlighting climatological, geological, and topographic features--operating practices--description of refuse and/or sludge quantities; discussion of scope and results of leachate, groundwater, soil, sludge, and gas monitoring at the case study sites; data evaluation and discussion of trends and relationships observed; description of sampling procedures; and delineation of laboratory analytical procedures. (Lantz-PTT)
W89-11885

HAZARDOUS AND TOXIC MATERIALS: SAFE HANDLING AND DISPOSAL.
For primary bibliographic entry see Field 5G.
W89-11898

INNOVATIVE ON-SITE TREATMENT/DESTRUCTION TECHNOLOGIES FOR REMEDIATION OF CONTAMINATED SITES.
URS Consultants, Inc., Long Beach, CA. Solid and Hazardous Waste Management Programs.
M. Ghassemi.
IN: Hazardous and Toxic Materials: Safe Handling and Disposal. John Wiley and Sons, New York. 1988. p 345-411, 20 fig, 11 tab, 81 ref.

Descriptors: *Decontamination, *Waste treatment, *Cleanup operations, *Water pollution treatment, Air trapping, Vapor extraction, Biological treatment, Vitrification, Land disposal, Temperature, Waste disposal, Landfills.

It is now widely recognized that the traditional approaches to the cleanup of contaminated sites consisting of site isolation and/or excavation and redisposal in land based containment systems do not provide the desired long-term environmental protection. Waste treatment and destruction can provide a more permanent solution and are now being actively evaluated as alternatives to waste relocation and site isolation. Treatment/destruction can be carried out on site (in situ or in mobile units) or at off-site facilities, with the former offering the advantage of eliminating risks associated with waste transportation to off-site locations. Seven in situ and four above-ground mobile-site cleanup technologies are reviewed from the standpoint of operating principle, state of development, reported experience, and application requirements. The in situ technologies discussed are bioreclamation, soil vapor extraction, air stripping, steam/hot air stripping, immobilization, soil washing, and vitrification. Three high-temperature destruction systems, one low-temperature stripping, and a soil-washing system are reviewed as examples of innovative technologies for mobile system applications. Technologies that have been considered or used in the past for mitigating problems at contaminated sites have emphasized site isolation using physical barriers and/or removal of contaminated soil and waste for disposal at off-site land-based disposal facilities. According to the Environmental Protection Agency (EPA), a total of 66 Record of Decisions (ROD) approved in fiscal year 1985 by the agency for remedial action at Superfund sites, 54% included off-site disposal of wastes as an element of the remedial action; on-site land filling (i.e., construction of an on-site containment facility or disposal cell to contain wastes) and site capping (i.e., construction of a synthetic, soil, or clay cap at the site to reduce infiltration into the waste) were involved in 42% of the cases. (See also W89-11898) (Lantz-PTT)
W89-11902

DESIGN SEMINAR HANDOUT: SLUDGE TREATMENT AND DISPOSAL.
For primary bibliographic entry see Field 5D.
W89-11908

ANAEROBIC DIGESTER GAS, SOLAR ENERGY AND SLUDGE COMPOSTING IN MUNICIPAL WASTEWATER TREATMENT.
G. M. Wesner.
IN: Design Seminar Handout: Sludge Treatment and Disposal. Environmental Protection Agency Environmental Research Information Center Technology Transfer, 1977. p 120-177, 10 fig, 9 tab, 28 ref.

Descriptors: *Digester gas, *Waste disposal, *Anaerobic digestion, *Solar energy, *Composting, *Municipal wastewater treatment, Sludge digestion, Sludge, Wastewater treatment, Fuel, Heating.

Sludge composting has received renewed interest recently. In an ongoing program, significant new data has been developed and an innovative composting system has been demonstrated. Municipal sludge composting operations are planned or in

operation at several locations in the United States. This paper evaluates the potential for use of anaerobic digester gas, solar energy and sludge composting in municipal wastewater treatment facilities. The use of anaerobic digester gas has been practiced to some extent in wastewater treatment plants for many years. Digester gas is currently being used at several plans to heat digesters and buildings and as fuel for engines that drive pumps, blowers and generators. Solar energy has not been used in operating treatment plants. Research has been conducted in Florida and Maryland on heating digesters and one small plant in Maine, will use solar energy for water, space and digester heating. (See also W89-11908) (Lantz-PTT)
W89-11911

CHEMICAL FIXATION OF WASTES.
Municipal Environmental Research Lab., Cincinnati, OH.
R. E. Landreth, and J. L. Mahloch.
IN: Design Seminar Handout: Sludge Treatment and Disposal. Environmental Protection Agency Environmental Research Information Center Technology Transfer, 1977. p 178-194, 3 fig, 3 tab, 6 ref.

Descriptors: *Waste disposal, *Wastewater treatment, *Chemical treatment, Municipal wastewater treatment, Research priorities, Field tests, Sludge, Land disposal, Sludge stabilization, Industrial wastes, Soil contamination, Leaching, Groundwater pollution, Literature review, Experimental data, Interagency cooperation.

The rapid increase in the volume of wastes requiring disposal to the land has caused concern over the potential buildup of pollutants from long-term application. Alternatives to the disposal of raw wastes are being assessed and in the more promising cases, demonstrated. One alternative under consideration is the chemical fixation of wastes. Chemical fixation may be defined as a process to limit or minimize the movement of contaminants of away from the disposal site and to improve the physical characteristics of the waste. Fixation usually imparts increased physical strength and protects the potential pollutants of the waste from dissolution by rainfall or by groundwater. The bulk of the data base for chemical fixation technology has been developed using inorganic industrial wastes and air abatement residues. Selected processors are now addressing municipal sewage sludge for chemical fixation but data are limited. Municipal sewage sludge data discussed in this paper were obtained from unpublished processor data. Current EPA research on chemical fixation is being conducted through an interagency agreement with the U.S. Army Corps of Engineers at the Waterways Experiment Station. This research includes: (1) literature review to identify known commercially available processors or processors far enough along in the development of a process to be considered for testing; (2) a laboratory phase, leachability and durability, to evaluate selected sludges; and (3) a field evaluation phase consisting of lysimeters and actual subsurface monitoring of fixed waste disposal sites. This research is being performed utilizing inorganic industrial wastes and air abatement residues. The laboratory phase of the research has recently been expanded to include municipal sewage sludges. (See also W89-11908) (Lantz-PTT)
W89-11912

INTRODUCTION TO THE PRINCIPLES OF LAND APPLICATION OF SLUDGE.
Environmental Protection Agency, Washington, DC. Office of Solid Waste.
For primary bibliographic entry see Field 5B.
W89-11913

PRELIMINARY ASSESSMENT OF THE EFFECTS OF SUBSURFACE SEWAGE SLUDGE DISPOSAL ON GROUNDWATER QUALITY,
For primary bibliographic entry see Field 5C.
W89-11914

PRINCIPLES OF LAND APPLICATION OF SEWAGE SLUDGE.
Purdue Univ., Lafayette, IN. Dept. of Agronomy.
L. E. Sommers.
IN: Design Seminar Handout: Sludge Treatment and Disposal. Environmental Protection Agency Environmental Research Information Center Technology Transfer, 1977. p 228-273, 6 fig, 16 tab, 21 ref.

Descriptors: *Wastewater disposal, *Land disposal, *Sludge disposal, Nutrient requirements, Environmental quality, Soil properties, Waste management.

The application of sewage sludge on land can be viewed from two standpoints--first, the rates of application are consistent with utilization of the plant nutrients in sludge by a growing plant (i.e., recycling approach), and second, the maximum possible amount of sewage sludge is applied in a minimum amount of time (disposal approach). From the standpoint of maintaining a quality environment, the recycling approach should be adopted when considering application of sewage sludges on agricultural land. The successful operation of a program utilizing application of sewage sludge on land is dependent on a knowledge of sludge, soil, and crop characteristics and of the management required to maintain environmental quality. The approach adopted in this discussion is to present information on: (1) sludge sampling and analysis; (2) soil properties and the fate of constituents added to soil in sewage sludge; (3) nutrient requirements of crops and techniques for assessing soil and crop interactions; (4) management methodologies; and (5) application techniques. (See also W89-11908) (Lantz-PTT)
W89-11915

SPRAY DISPOSAL OF TREATED DOMESTIC WASTEWATER ON UPLAND FRAGIPAN SOILS IN A SEVERE WINTER CLIMATE.
Vermont Dept. of Water Resources, Montpelier.
P. H. Flanders.
IN: Water Pollution Control in Low Density Areas: Proceedings of a Rural Environmental Engineering Conference, September 26-28, 1973, Warren, Vermont. University Press of New England, Hanover, New Hampshire, 1975. p 15-21, 4 fig, 1 tab, 8 ref.

Descriptors: *Wastewater disposal, *Wastewater irrigation, *Spray irrigation, Fragipan soils, Soil properties, Regulations, Cold regions, Vermont, Seasonal variation, Temperature, Ice.

On May 27, 1971, the Vermont Water Resources Board adopted 'Regulations Governing Water Classification and Control of Quality,' which established as 'pristine streams' those with flow above an elevation of 1500 ft or a rate of flow of < 1.5 cu ft/sec at any elevation and prohibited discharges to them that would degrade their quality in any respect. The adoption of these regulations initiated a search for an alternate disposal method in the upland areas of severe soil conditions. Much of Vermont, however, is subject to high perched water tables, shallow soils to bedrock, and land slopes in excess of 8%. Winter temperatures in Vermont are often -25 C to -30 F with high temperatures for some days not exceeding 0 F. A desire to protect the groundwater resources focused investigations on the fragipan soils because of their natural protection against direct recharge. After this manner of evaluating the hydraulic capacity of fragipan and an acceptable spray disposal site was determined, the question of whether spraying during winter months would produce the desired results was still to be answered. A small experimental spray system was operated for two winters to evaluate the effects of winter spraying. One of the first discoveries from observation and ice sampling was that selective freezing was occurring within temperature ranges from 10 F to 32 F, which affected the quality of ice formed and of the effluent entering the soil. At temperatures below 10 F, the ice quality approached the quality of the effluent. During operation of the system the spray falls on the ice formed the previous week and flows laterally over it to the lower edge where it percolates through the snow and enters the soil. These operation and design features, which include an effluent storage facility with capacity to store two months flow for complete holding during April and May, are summarized as: (1) sprinkler layout with nonoverlapping patterns in the direction of surface water movement; (2) storage pond with capacity to store two months of wastewater volumes; (3) system pumps and pipes designed to deliver the average daily flow to the disposal field in an 8-hr period; (4) no spraying when temperatures are < 10 F; and (5) dual pumps and valving such that two separate areas could be sprayed simultaneously in an 8-hr period to allow disposal of effluent stored during the cold periods. (See also W89-11953) (Lantz-PTT)
W89-11955

LAND TREATMENT OF WASTEWATERS FOR RURAL COMMUNITIES.
Cold Regions Research and Engineering Lab., Hanover, NH.
For primary bibliographic entry see Field 5D.
W89-11956

LIMITS TO GROWTH AND SEPTIC TANKS.
Connecticut Univ., Storrs. Dept. of Geology and Geophysics.
T. L. Holzer.
IN: Water Pollution Control in Low Density Areas: Proceedings of a Rural Environmental Engineering Conference, September 26-28, 1973, Warren, Vermont. University Press of New England, Hanover, New Hampshire, 1975. p 65-74, 5 fig, 2 tab, 16 ref.

Descriptors: *Waste management, *Management planning, *Septic tanks, *Waste disposal, Wastewater treatment, Groundwater quality, Soil contamination, Nitrates, Connecticut.

In regions where groundwater circulates in a relatively thin zone near the surface, an estimation of the quantity of annual recharge to groundwater makes it feasible to compute the maximum population which the region can support if waste disposal is via septic tank systems and water supplies are extracted on site. Since final treatment by the groundwater system primarily is dilution with uncontaminated recharge, the ability of soils to renovate effluent must be known. If septic tank systems are situated in areas with well-drained soils and relatively deep water tables, nitrate is the final product of primary concern after renovation by the soil. In eastern Connecticut, the dilution required to reduce concentrations of nitrate to 45 mg/L indicates that average residential densities within groundwater basins covered by till should not be greater than one residence/acre. Such an estimate of maximum density is based on the requirement that septic tank systems cause only chemical contamination of groundwater by effluent. In some regions, soil, hydrologic, and topographic conditions unfavorable to septic tank systems may place more stringent limitations on development than the limitations imposed by safeguarding groundwater quality. These conditions prevail in much of eastern Connecticut. Regardless of which analysis places the greater limitation on development, regional planning of the distribution of residential development is necessary in order to minimize the public health problems caused by community dependence on septic tank systems for waste disposal. (See also W89-11953) (Lantz-PTT)
W89-11959

ANALYSIS OF SEPTIC TANK SURVIVAL DATA FROM 1952 TO 1972 IN FAIRFAX COUNTY VIRGINIA,
Fairfax County Health Dept., VA. Div. of Environmental Health.
J. W. Clayton.
IN: Water Pollution Control in Low Density Areas: Proceedings of a Rural Environmental Engineering Conference, September 26-28, 1973, Warren, Vermont. University Press of New England, Hanover, New Hampshire, 1975. p 75-87, 4 fig, 4 tab.

Descriptors: *Waste management, *Septic tanks, *Waste disposal, *Regulations, *Virginia, *Fairfax County, Soil properties.

Fairfax County, Virginia has records of septic tank systems installed in the 1930's and officials are aware that some were installed even earlier. In 1949, septic tank systems were installed with a minimum of supervision and concern for the types of soil conditions. In one area of the county there were hundreds of malfunctioning systems with no means for correction. The problem necessitated a $20 million bond issue for sanitary sewers in 1953, the first real expansion of the county sewer construction and extension program. This created the need to identify these questionable soils. During 1954 and 1955 while a soils survey was being conducted and mapped, environmental health officials worked closely with the soil scientists to make correlation studies comparing percolation rates with certain soils, which showed that water table soils could be identified by type and eliminated from future consideration for individual sewage disposal systems with subsurface absorption. It also became apparent that the county's septic tank ordinance at that time was quite inadequate and a committee was appointed by the Board of Supervisors to prepare a more modern ordinance incorporating the new concepts in the design and installation of septic tank systems. Some of the major factors included in the ordinance are: (1) the use of percolation tables for sizing drainfields and seepage pit systems; (2) specific construction requirements for tanks, drainfields, and pit systems; and (3) bonding and licensing contractors before permitting them to engage in septic tank system construction. By 1971-73, building in Fairfax County had reached a peak and the sanitary sewers and sewage treatment facilities were crowded to maximum use. In 1972, officials found: (1) that the average life of an individual sewage disposal system with an absorption field or seepage pits was then averaging about 20 to 30 yrs instead of the 15 to 20 yrs they were quoting; (2) the analysis of almost 6,000 systems on an annual basis yielded survival rates of at least 94%; and (3) of 75 systems whose failures were resolved by connection to public sewers, the median life span was about 18 yrs, and 88% had life spans of at least 10 yrs. (See also W89-11953) (Lantz-PTT)
W89-11960

USE OF SOIL FOR DISPOSAL AND TREATMENT OF SEPTIC TANK EFFLUENT.
Wisconsin Univ., Madison. Dept. of Soil Science.
For primary bibliographic entry see Field 5D.
W89-11961

VIRUS MOVEMENT INTO GROUNDWATER FROM SEPTIC TANK SYSTEMS.
Maine Univ., Orono. Dept. of Civil Engineering.
For primary bibliographic entry see Field 5B.
W89-11965

WATER QUALITY AND SOLID WASTE PROBLEMS IN RURAL NEW MEXICO AND SOME SOLUTIONS.
Environmental Improvement Agency, Tesuque, NM. Water Supply Div.
For primary bibliographic entry see Field 5G.
W89-11971

THIRTY-FIVE YEARS OF USE OF A NATURAL SAND BED FOR POLISHING A SECONDARY-TREATED EFFLUENT.
Rensselaer Polytechnic Inst., Troy, NY. Dept. of Environmental Engineering.
For primary bibliographic entry see Field 5D.
W89-11972

EVALUATION OF PROPOSED ANIMAL MANURE HANDLING PRACTICES.
Texas Tech Univ., Lubbock. Dept. of Civil Engineering.
G. A. Whetstone.
IN: Water Pollution Control in Low Density Areas: Proceedings of a Rural Environmental Engineering Conference, September 26-28, 1973, Warren, Vermont. University Press of New England, Hanover, New Hampshire, 1975. p 359-367, 37 ref.

Descriptors: *Waste disposal, *Manure, *Farm wastes, Recycling, Waste treatment.

It has been calculated that the gross national production of manure exceeds two billion tons/yr. Much of this is deposited directly on range or pasture to be recycled in ways which gladden an ecologist's heart. Moreover, the manure which accumulates in barnyards, chicken houses, and milking parlors has traditionally been returned to the land for its fertilizer and soil conditioner values. Now three significant trends are rendering this procedure inadequate: (1) the operators of feedlots, finishing pens, or poultry houses frequently have insufficient land under their control for beneficial spreading to be feasible; (2) confined feeding operations have tended to locate near the edges of towns where transportation and other facilities were available. This has reduced both the area available for land application of manure and the acceptance by neighbors of the practice; and (3) pollution has become anathema. If costs could be disregarded, the most acceptable alternative to land spreading is the thermochemical alteration of manure to obtain such products as electricity, oil, gas, or building materials. The market for them is essentially unlimited, and the unit value of energy is certain to increase in the future. Costs are formidable, however. Refeeding, although once practiced on American farms, is now strongly discouraged. Utilization of manure as a component of feed is currently forbidden in the U.S.A., although it is legal in Canada and the United Kingdom. Research has been encouraged in the States, and a considerable body of knowledge has been accumulated, though not all of it has been placed in the public domain. However, the idea behind refeeding is a valuable one, and should be the subject of continued research in the U.S.A. Land disposal of manure is frequently accompanied by a plowing in for the dual purpose of retaining volatile nutrients in the soil, where they may be beneficial and of keeping them out of the air, where they constitute a nuisance. (See also W89-11953) (Lantz-PTT)
W89-11978

WATER SUPPLY AND WASTEWATER DISPOSAL: INTERNATIONAL ALMANAC, VOLUME 1.
For primary bibliographic entry see Field 5F.
W89-11983

WATER SUPPLY AND WASTEWATER DISPOSAL: INTERNATIONAL ALMANAC, VOLUME 2.
For primary bibliographic entry see Field 5F.
W89-11984

WATER SUPPLY AND WASTEWATER DISPOSAL: INTERNATIONAL ALMANAC, VOLUME 3.
For primary bibliographic entry see Field 5F.
W89-11985

WATER SUPPLY AND WASTEWATER DISPOSAL: INTERNATIONAL ALMANAC, VOLUME 4.
For primary bibliographic entry see Field 5F.
W89-11986

WATER SUPPLY AND WASTEWATER DISPOSAL: INTERNATIONAL ALMANAC, VOLUME 5.
For primary bibliographic entry see Field 5F.
W89-11987

WATER SUPPLY AND WASTEWATER DISPOSAL: INTERNATIONAL ALMANAC, VOLUME 6.
For primary bibliographic entry see Field 5F.
W89-11988

WATER SUPPLY AND WASTEWATER DISPOSAL: INTERNATIONAL ALMANAC, VOLUME 7.
For primary bibliographic entry see Field 5F.
W89-11989

WATER SUPPLY AND WASTEWATER DISPOSAL: INTERNATIONAL ALMANAC, VOLUME 8.
For primary bibliographic entry see Field 5F.
W89-11990

WATER SUPPLY AND WASTEWATER DISPOSAL: INTERNATIONAL ALMANAC, VOLUME 9.
For primary bibliographic entry see Field 5F.
W89-11991

HWHM 88: HAZARDOUS WASTES AND HAZARDOUS MATERIALS.
Proceedings of the 5th National Conference held April 19-21, 1988, Las Vegas, Nevada. 1988. 571p.

Descriptors: *Hazardous wastes, *Waste disposal, *Cleanup operations, *Water pollution prevention, *Conferences, Monitoring, Waste management, Water pollution treatment, Groundwater pollution, Wastewater treatment, Waste disposal sites, Incineration, Soil contamination, Radioactive wastes, Organic compounds, Fate of pollutants, Leachates, Legislation, Regulations.

By 1987, there were more than 1000 sites included or proposed for the National Priorities List (NPL) of Superfund. Remedial investigations and feasibility studies have been conducted at more than 300 NPL sites. Sixty sites are being cleaned up and emergency cleanups have been initiated at about 400 NPL and non-NPL sites. There are also some NPL sites that are being cleaned up by private groups under EPA supervision. Under the Comprehensive Environmental Response Compensation and Liability Act (CERCLA) or 'Superfund', EPA developed a strategy composed of three major elements. The first called for assessing the uncontrolled hazardous waste sites in the Agency's current inventory. Second, those sites which presented an imminent threat to public health or the environment were to be stabilized. Third, using the National Contingency Plan for guidance, the NPL sites were ranked to receive priority attention for remedial cleanup action. These 'Proceedings' contain more than 130 papers and seminar outlines that emphasize the latest developments and cumulative experiences gained from the spectrum of the Resource Conservation and Recovery Act and Superfund activities. The papers are presented within the following divisions: (1) contaminated aquifer control; (2) hazardous waste treatment; (3) waste minimization; (4) contaminated soil treatment; (5) in situ treatment; (6) barrier construction; (7) incineration; (8) site remediation; (9) spills and cleanup; (10) disposal site management; (11) site closure; (12) underground storage tanks; (13) RAD waste and mining; (14) risk assessment; (15) monitoring and sampling; (16) volatile hazardous materials detection and management; (17) volatile organic management; (18) fate of contaminants; (19) health and endangerment; (20) leachate; (21) Federal policy papers; (22) Title III and public right-to-know; (23) environmental assessment; (24) liability; and (25) state and local programs. (See also W89-12002 thru W89-12074) (Lantz-PTT)
W89-12002

PRACTICAL APPROACH FOR THE BIOLOGICAL REMEDIATION OF HAZARDOUS WASTE SITES.
Bioprocess Engineering, Inc., Wilmington, DE.
For primary bibliographic entry see Field 5G.
W89-12022

FIELD INVESTIGATION OF MACROFEATURES IN COMPACTED SOIL.
Brown (K.W.) and Associates, Inc., College Station, TX.
For primary bibliographic entry see Field 5B.
W89-12026

CONSTRUCTION QUALITY ASSURANCE FOR SAND-BENTONITE LINERS.
Ardaman and Associates, Inc., Orlando, FL.
J. E. Garlanger, and F. K. Cheung.
IN: HWHM 88: Hazardous Wastes and Hazardous Materials. Proceedings of the 5th National Conference held April 19-21, 1988, Las Vegas, Nevada. 1988. p 192-197, 9 fig, 6 tab, 7 ref.

Descriptors: *Waste disposal, *Liners, *Water pollution prevention, *Sand, *Landfills, *Quality control, Construction, Waste disposal, Bentonite, Soil compaction, Permeability.

The quality control program for the construction of a sand-bentonite sanitary landfill liner in Osceola County, Florida is described and the methodologies and procedures used to interpret the test data and assess the performance of the installed liner are discussed. The available borrow soil was a fine sand with an average fines content of approximately 3%. The specified permeability of the 8-in. thick sand-bentonite liner was 10 microcentimeters (ucm)/sec or less. Preliminary testing of sand-bentonite mixes was conducted in the laboratory to evaluate the feasibility of various bentonite products to be used for actual production. Three test strips were constructed at the landfill site prior to actual production to evaluate the field mixing and construction procedures. The test results indicate that a bentonite content of approximately 7.5% was required under field processing conditions to achieve the specified permeability of 10 ucm/sec compared to a bentonite content of about 4% that was required under laboratory processing conditions. A nominal bentonite content of 8.8% was used for actual production to account for variation of bentonite content within the liner resulting from the limitations of the field spreading and mixing procedures. Based on the test data collected during actual production, the installed liner has an average thickness of 8.3 in. and a calculated equivalent coefficient of permeability of 4.7 nanocm/sec. In terms of seepage rate and leachate retention time, the installed liner exceeds both the Florida Department of Environmental Regulation bottom liner design standards and the proposed design criteria. (See also W89-12002) (Lantz-PTT)
W89-12027

HYDRAULIC CHARACTERISTICS OF MODEL SOIL-BENTONITE SLURRY CUTOFF WALLS.
Cincinnati Univ., OH. Dept. of Civil and Environmental Engineering.
For primary bibliographic entry see Field 5G.
W89-12028

DESIGN AND CONSTRUCTION OF EFFECTIVE SOIL LINERS.
Brown (K.W.) and Associates, Inc., College Station, TX.
For primary bibliographic entry see Field 5G.
W89-12029

CHEMICAL COMPATIBILITY TESTING OF GEOSYNTHETICS TO BE USED AS CONTAINMENT BARRIERS IN HAZARDOUS WASTE MANAGEMENT.
Texas Research Inst., Inc., Austin.
For primary bibliographic entry see Field 8G.
W89-12030

ORGANIC FLUID EFFECTS UPON BENTONITE.
Bentec, Ferndale, MI.
For primary bibliographic entry see Field 5G.
W89-12031

EVALUATION OF REMEDIAL ALTERNATIVES FOR AN INACTIVE INDUSTRIAL LANDFILL.
Weston (Roy F.), Inc., West Chester, PA.
For primary bibliographic entry see Field 5G.
W89-12032

DEVELOPMENT AND OPERATION OF AN EFFICIENT CYCLONIC INCINERATION DEMONSTRATION SYSTEM FOR INDUSTRIAL WASTEWATER.
Institute of Gas Technology, Chicago, IL.
For primary bibliographic entry see Field 5D.
W89-12033

HANSCOM AFB HAZARDOUS WASTE DISPOSAL AREA CLEANUP.
Engineering-Science, Inc., Syracuse, NY.
For primary bibliographic entry see Field 5G.
W89-12034

WASTE DISPOSAL IN THE FEDERAL REPUBLIC OF GERMANY.
Bilfinger und Berger Bauaktiengesellschaft, Mannheim (Germany, F.R.).
V. Gossow, and P. Aubel.
IN: HWHM 88: Hazardous Wastes and Hazardous Materials. Proceedings of the 5th National Conference held April 19-21, 1988, Las Vegas, Nevada. 1988. p 306-309, 6 fig.

Descriptors: *Waste disposal, *Water pollution prevention, *West Germany, *Hazardous wastes, Containment, Leachates, Storage facilities, Waste storage.

The Federal Waste Disposal Act of August 27, 1986, has created the legal basis for the orderly disposal of waste in the Federal Republic of Germany. A newly developed multi-layer base sealing system, which provides for inspection of its efficacy and repair, is outlined. Special emphasis is on the avoidance or minimization of leachate, currently the most significant problem in the field of waste disposal. The various roof structures which can be used to protect the waste against precipitation and the attendant formation of leachate are examined and compared. In this connection, a new, maintenance-free roof structure which has no intermediate supports and allows spans of up to 300 m., has a relatively low deadweight and can be shifted longitudinally, thus causing no downtime costs or costly relocation. The structure's high cost-effectiveness is another important factor. The combination of efficient base sealing systems, disposal techniques aimed at the reduction of leaching of the waste and roofing the dumping areas, constitutes optimum waste disposal technology. (See also W89-12002) (Lantz-PTT)
W89-12041

CLOSING A HAZARDOUS WASTE FACILITY: ENVIRONMENTAL CONCERNS.
Environmental Science and Engineering, Inc., Salt Lake City, UT.
D. L. Whiting.
IN: HWHM 88: Hazardous Wastes and Hazardous Materials. Proceedings of the 5th National Conference held April 19-21, 1988, Las Vegas, Nevada. 1988. p 310-313, 6 fig, 2 tab.

Descriptors: *Superfund, *Waste disposal sites, *Hazardous wastes, *Project planning, Waste disposal, Management planning, Waste storage, Costs, Water pollution prevention, Landfills, Leachates.

Provisions for closure and post-closure care are an integral part of the waste control system. Accordingly, under Resource Conservation and Recovery Act (RCRA) Section 3005(a), all treatment, storage and disposal of hazardous wastes is prohibited without a permit in accordance with the Section 3004 standards. The applicability of these provisions to hazardous waste sites in industry and at governmental facilities are discussed. A general discussion on the closure and post-closure provisions of RCRA regulations as currently amended with emphasis on the engineering and environmental aspects are presented. The requirements for run-on/runoff control, pond lining, leachate control and groundwater monitoring as related to landfills, impoundments, waste piles, incinerator and underground tank control systems are also discussed. Cost factors are presented only to illustrate the potential impacts since exact costs are specific to each individual site. (See also W89-12002) (Lantz-PTT)
W89-12042

SITE CHARACTERIZATION AND CLOSURE.
ERT, Inc., Camarillo, CA.
For primary bibliographic entry see Field 5G.
W89-12044

CLOSURE OF A RCRA IMPOUNDMENT BY BIODEGRADATION AND FIXATION.
Monsanto Chemical Co., St. Louis, MO.
B. S. Yare, and E. F. Stecher.
IN: HWHM 88: Hazardous Wastes and Hazardous Materials. Proceedings of the 5th National Conference held April 19-21, 1988, Las Vegas, Nevada. 1988. p 328-331, 2 fig, 5 tab.

Descriptors: *Sludge stabilization, *Industrial wastes, *Biodegradation, *Waste disposal, Sludge digestion, Waste storage, Containment.

An attempt was made to close a 5-acre Resource Conservation and Recovery Act impoundment at Monsanto's Pensacola, Florida, facility using biodegradation. Due to a larger than anticipated volume of sludge, problems with sludge dewatering and excessive precipitation, the attempt was unsuccessful. As an alternative to biodegradation, the sludge was stabilized using a 5:2 mix of sludge to fly ash with the addition of 1% sodium silicate. The stabilized sludge had a bearing capacity of 2,000 lb/sq ft. A high density polyethylene lined vault was constructed at one end of the impoundment and the stabilized sludge was placed in it. (See also W89-12002) (Author's abstract)
W89-12045

STRATEGIES FOR EXTERNAL LEAD DETECTION OF UNDERGROUND STORAGE TANKS.
Environmental Monitoring and Support Lab., Las Vegas, NV.
For primary bibliographic entry see Field 7A.
W89-12047

SITE CLOSURE AND PERPETUAL CARE OF A LOW-LEVEL RADIOACTIVE WASTE DISPOSAL FACILITY IN SEMI-ARID CLIMATE.
P. N. Singh, K. H. Breeden, and S. L. A. Hana.
IN: HWHM 88: Hazardous Wastes and Hazardous Materials. Proceedings of the 5th National Conference held April 19-21, 1988, Las Vegas, Nevada. 1988. p 351-358, 6 fig, 6 tab, 35 ref.

Descriptors: *Semiarid climates, *Radioactive wastes, *Waste disposal sites, *Waste management, *Water pollution prevention, Monitoring, Vegetation, Maintenance, Infiltration, Waste disposal, Groundwater, Vadose zone.

A study has been performed on site closure and perpetual care and maintenance requirements for the commercially operated low-level radioactive waste (LLRW) disposal facility, referred to as the Richland Facility, on the Hanford Reservation near Richland, Washington. The study included a site assessment and identification and formulation of site specific design elements for closure and perpetual care and maintenance. Three release mechanisms and four destructive processes are considered in the conceptual closure design process. The release mechanisms considered include subsurface liquid movement, biomechanisms considered include subsurface liquid movement, biological transport of wastes to the surface and subsurface gas movement. The destructive processes considered are wind erosion, biological penetration or damage of cover, vegetation destroying processes and subsidence and seismic activity. The most serious closure concerns appear to be the need to limit infiltration through the waste, the need to inhibit biological transport of wastes to the surface and the need to protect the cover system from various destructive processes. The most important element for the limitation of infiltration is the establishment of a deep-rooted vegetative cover over the waste trenches. Because the effect of vegetation depends on climatic conditions and varies seasonally and because certain natural processes can cause intermittent destruction of plant populations, a secondary defense against infiltration is needed. A combination of vegetation and a surface layer including coarse material is needed to protect

the cover against wind erosion. Post-closure activities include security, maintenance of the cover system and monitoring. Over the long-term, after the lapse of institutional control, security will depend heavily on the cover system itself, particularly on the biotic barrier. Maintenance of the cover through the period of institutional control will depend on regular inspection and on the monitoring program. Local monitoring on the Richland Facility should include plant tissue monitoring, vadose zone monitoring, groundwater monitoring and monitoring within the cover system. (See also W89-12002) (Lantz-PTT)3985000
W89-12049

STATE REGULATORY APPROACHES TO MANAGEMENT OF MINING WASTES.
CDM Federal Programs Corp., Fairfax, VA.
For primary bibliographic entry see Field 6E.
W89-12050

HAZARD RANKING: A JOB FOR GEOGRAPHIC INFORMATION SYSTEMS.
Nevada Univ., Las Vegas. Environmental Research Center.
C. K. Fitzsimmons, M. J. Hewitt, and F. Mynar.
IN: HWHM 88: Hazardous Wastes and Hazardous Materials. Proceedings of the 5th National Conference held April 19-21, 1988, Las Vegas, Nevada. 1988. p 381-385, 3 fig, 4 tab, 7 ref. EPA Contracts CR812189-01 and 68-0-245.

Descriptors: *Geographic information systems, *Waste disposal, *Risk assessment, *Maps, *Hazardous wastes, *Information systems, *Project planning, Path of pollutants, Public health, Groundwater pollution, Databases, Water pollution.

The implementation of EPA's Hazard Ranking System (HRS) is assessed in a geographic information system (GIS) environment. The requirements of the HRS for determining potential risk from hazardous waste sites to humans and to natural systems via air, surface water, groundwater, fire and explosion and direct contact routes are explored. The information requirements of the HRS are broken down into thematic layers and are matched with GIS operational tools to provide an assessment of how the GIS could provide an objective HRS score. Polygonal data representing aquifer boundaries, soils, depth to aquifer, precipitation, evaporation, and population may be achieved in a geographic information system to serve as input to the HRS process. These data combined with the distance to the nearest well and the population served result in a synoptic map of groundwater exposure routes. Overlaying waste location with slopes, rainfall, land use, location of intake points and population data provides a synoptic view of surface water exposure routes and permits the calculation of an HRS score. (See also W89-12002) (Author's abstract)
W89-12053

RISK ASSESSMENT FOR HAZARDOUS MATERIALS CONTAINMENT STRUCTURE.
Texas Univ. at San Antonio.
C. S. Shih, and A. Arroyo.
IN: HWHM 88: Hazardous Wastes and Hazardous Materials. Proceedings of the 5th National Conference held April 19-21, 1988, Las Vegas, Nevada. 1988. p 389-400, 6 fig, 11 tab, 10 ref.

Descriptors: *Waste disposal, *Containment, *Concrete structures, *Hazardous wastes, *Risk assessment, *Waste management, Reinforced concrete, Structural engineering, Design standards, Concrete testing.

Risk assessment for reinforced concrete containment structures has become a major concern to the planners, engineers and site managers for hazardous material control and disposal and to the public in general. The failure of these structures has led to the leakage or exfiltration of hazardous materials to its surroundings. However, failure mechanisms may include engineering defects such as improper design specifications for liner and reinforced concrete, improper mixes for liner and concrete, unsatisfactory quality of materials used for either one or both, mishaps during construction, incomplete detailing, or lack of sound inspections. Failure also could be triggered due to incomplete knowledge and subsequent ill-conceived design in response to specific geotechnical considerations including such information as wetting and drying cycles, or spatial freeze-thaw cycles. The successful containment of hazardous materials requires thorough evaluation of alternative courses of action during both design and construction phases, while the minimization of failure is the primary objective. This evaluation can use an adaptation of modern risk assessment methodology. The authors have developed an integrated risk assessment methodology based on event tree and fault tree analyses coupled with revealed preference evaluation. A comprehensive fault tree for a typical lined hazardous waste reinforced concrete containment structure has been developed. A series of sensitivity analyses using the fault tree as the basic framework has been conducted to assess the relative impacts of various engineering design sub-tasks upon the structural stability and containment effectiveness. (See also W89-12002) (Lantz-PTT)
W89-12055

DEVELOPMENT AND EFFECT OF LEAK DETECTION REGULATIONS.
PEI Associates, Inc., Englewood, CO.
For primary bibliographic entry see Field 5G.
W89-12069

COUNTY SPECIFIC HAZARDOUS WASTE MANAGEMENT PLANS.
Brown, Vence and Associates, San Francisco, CA.
For primary bibliographic entry see Field 5G.
W89-12071

MUNICIPAL HAZARDOUS MATERIALS MANAGEMENT PROGRAMS IN CALIFORNIA.
PRC Environmental Management, Inc., San Francisco, CA.
D. P. DeRienzo, and T. P. Adkisson.
IN: HWHM 88: Hazardous Wastes and Hazardous Materials. Proceedings of the 5th National Conference held April 19-21, 1988, Las Vegas, Nevada. 1988. p 536-540, 2 tab.

Descriptors: *Water pollution prevention, *Municipal wastes, *Hazardous wastes, *Waste disposal, *Waste management, *Regulations, *California, Waste storage, Local governments, Legal aspects, Monitoring, Groundwater pollution.

As implementing agencies of hazardous materials storage regulations, municipalities are required to develop programs and procedures for inspecting and permitting business and for maintaining records and databases of hazardous materials information. The implementation and startup of a hazardous materials storage ordinance enforcement program for the city of Fremont, CA is described. Included are discussions on identifying businesses that are regulated under the ordinance, reviewing and approving business plans, performing compliance inspections and addressing the data management and records management necessary to comply with the state laws. The city's hazardous materials storage permit programs are the vehicles for enforcement of: (1) the local hazardous materials storage ordinance; (2) underground storage tank laws including groundwater monitoring requirements; and (3) community right-to-known laws. The programs developed by cities, such as Fremont, can be used as guidance for other cities throughout the country as local involvement in hazardous materials management increases. (See also W89-12002) (Lantz-PTT)
W89-12072

CORRECTIVE ACTION AT SOLID WASTE MANAGEMENT UNITS UNDER A RCRA PERMIT; AN AUTHORIZED STATE'S EXPERIENCE.
Georgia Environmental Protection, Atlanta.
J. Ussery, and B. Langley.
IN: HWHM 88: Hazardous Wastes and Hazardous Materials. Proceedings of the 5th National Conference held April 19-21, 1988, Las Vegas, Nevada. 1988. p 541-544.

Descriptors: *Groundwater pollution, *Water pollution prevention, *Legislation, *Waste management, *Solid wastes, Resource Conservation and Recovery Act, Case studies, Permits, Georgia, Waste disposal, Chemical industry, Organic compounds.

The Hazardous and Solid Waste Amendments of 1984 (HSWA) mandate profound changes in the way that hazardous waste is managed in the United States. The most significant and far reaching provision of the HSWA is found in Section 206 which amends Section 3004 of the Solid Waste Disposal Act by adding a new subsection entitled 'Continued Releases at Permitted Facilities.' This provision later codified in 40 CFR, Section 264,101, provides that all permits issued after the date of enactment require corrective action for releases of hazardous waste or hazardous waste constituents from any solid waste management unit, regardless of when the waste was placed in the unit, or whether the unit is closed. Permits must include compliance schedules (where corrective action cannot take place prior to issuance of the permit) and assurance of financial responsibility. On Sept. 18, 1986, the State of Georgia became the first state in the country to receive full authorization for the administration of all the HSWA provisions. Since that time Georgia has issued numerous permits which incorporate the requirement for corrective action for releases from solid waste management units. These permits contain schedules for completing investigations of releases from solid waste management units and for developing acceptable corrective actions. Georgia's experience in developing permits which incorporate remedial investigations of, and corrective actions for, releases from solid waste management units are discussed. Several case histories are presented including a detailed case study of a chemical plant with groundwater contamination from volatile organics arising from solid waste management units. (See also W89-12002) (Author's abstract)
W89-12073

LONG-TERM SAND CAP STABILITY: NEW YORK DREDGED MATERIAL DISPOSAL SITE.
Science Applications, Inc., Newport, RI.
J. H. Parker, and R. M. Valente.
Available from the National Technical Information Service, Springfield, VA 22161, as AD-A98 651. Price codes: A04 in paper copy, A01 in microfiche. Contract Report CERC-88-2, July 1988. Final Report. 75p, 39 fig, 4 tab, 15 ref. Department of the Army Contract DACW38-86-C-0076.

Descriptors: *Spoil disposal, *New York, *Coastal waters, *Waste disposal, *Dredging, *Capping, Bathymetry, Erosion, Sediment distribution, Sand, Sedimentation, Bioturbation, Environmental effects.

A comprehensive physical oceanographic field study was conducted in November 1987 to determine the bathymetry of the New York Mud Dump site and assess the long-term stability of an experimental sand cap, or Experimental Mud Dump (EMD), located in the southeast quadrant of the site. Results of a precision bathymetric survey were compared with results from surveys conducted in 1980 and 1981. With a sediment-profile camera survey was conducted over the entire site, and a sub-bottom profiling survey was conducted at the EMD. A significant accumulation of sediment was found at the dredged material disposal point in the northeast quadrant, and decreases in depth to the south and east of this point indicated accumulation of dredged material beyond the eastern boundary of the site. Significant erosion of the sand cap was not detected, and clean sand representing the final cap material was found to persist in a continuous layer in the center of the EMD. A few patches of finer-grained material, possibly dredged material transported from the north were found to exist over the sand. The effects of bioturbation on the sand cap appeared to be negligible. It

was suggested that monitoring should occur during and following disposal operations to ensure adequate management control and later to assess the stability and environmental impacts of disposal mounds. (Author's abstract)
W89-12094

LABORATORY STUDIES OF METHODS FOR THE TREATMENT AND DISPOSAL OF THE WASTE STREAM FROM THE SILVER-RECOVERY FACILITY AT OAK RIDGE NATIONAL LABORATORY.
Oak Ridge National Lab., TN.
For primary bibliographic entry see Field 5D.
W89-12098

TREATABILITY STUDIES FOR WATERS IN THE OIL POND NO. 1, OIL POND NO. 2, AND THE OIL SEEP.
Oak Ridge National Lab., TN.
For primary bibliographic entry see Field 5G.
W89-12099

ENVIRONMENTAL POLLUTION CONTROL ALTERNATIVES: SLUDGE HANDLING, DEWATERING, AND DISPOSAL ALTERNATIVES FOR THE METAL FINISHING INDUSTRY.
Centec Corp., Reston, VA.
Industrial Environmental Research Laboratory Technology Transfer Report EPA 625/5-82-018, October 1982. 36p, 17 fig, 10 tab, 20 ref.

Descriptors: *Wastewater treatment, *Environmental protection, *Water pollution control, *Waste disposal, *Waste management, *Sludge disposal, *Metal-finishing wastes, Heavy metals, Sludge drying, Costs, Regulations, Clean Water Act, Hazardous wastes, Wastewater treatment, Sludge conditioning, Pressure filtration, Vacuum filtration, Compression filtration, Centrifugation, Landfills, Leaching, Groundwater pollution, Economic justification, Cost analysis, Capital costs, Performance evaluation, Labor.

Under regulations implementing the Clean Water Act of 1977, metal-finishing facilities may be required to treat spent process wastewaters to remove regulated pollutants before the wastewaters are discharged. An overview of the regulatory framework is provided for hazardous waste disposal, disposal methods and associated costs of secure chemical landfills are reviewed, the factors influencing waste generation and what can be done to reduce waste volume and the cost of disposal are considered and the types of dewatering equipment available and their cost and performance are evaluated. Hazardous wastes are regulated from the time they are created to the time of their disposal. Strict civil penalties can be imposed for violations of the regulations. The secure chemical landfill is designed to preclude the risk of groundwater contamination by heavy metals that could leach through the soil and into the groundwater. The high cost of disposal provides a strong incentive for reducing sludge volume. After wastewater treatment, the dilute sludge can be dewatered mechanically to reduce the volume by 90 to 95%. Pressure filters, vacuum filters, centrifuges, and compression filters can be used for mechanical dewatering of electroplating sludges. Criteria for selecting one of the foregoing devices for a specific application include sludge properties (solids concentration, particle size, compressibility), volume of sludge to be dewatered, and local disposal requirements. If disposal costs are less than $15,000/yr, it is unlikely that dewatering equipment would be justified economically. The lowest-cost alternatives in terms of capital investment are filter presses and small manual basket centrifuges. Minimum-size versions of both systems can be installed for under $30,000. The small filter-press system, although equal in cost to the centrifuge, will usually have more capacity. At low feed rates, the cost per unit of capacity is lowest for the filter press. The low capacity per cycle of the basket centrifuge will require significant operating labor at flow rates above 10 to 15 gal/h. Poor-filtering sludges can usually be dewatered by precoat vacuum filtration. With polyelectrolyte conditioning, most sludges can be dewatered effectively with a centrifuge or belt filter. (Lantz-PTT)
W89-12127

LINERS FOR WASTE DISPOSAL AND WASTE STORAGE FACILITIES, JANUARY 1976-APRIL, 1988: CITATIONS FROM THE ENERGY DATA BASE.
National Technical Information Service, Springfield, VA.
Available from National Technical Information Service, Springfield, VA 22161 as PB88-863147, Price codes: N01 in paper copy, N01 in microfiche. April 1988. 69p. Supersedes PB87-857082.

Descriptors: *Radioactive waste disposal, *Waste disposal, *Hazardous materials, *Bibliographies, *Linings, Leachates, Water pollution prevention.

This bibliography contains citations concerning the design, characteristics, and performance of various types of liners employed in the disposal and storage of a variety of hazardous and non-hazardous wastes. Special attention is given to uranium tailings and radioactive wastes. Descriptions of specific facilities are also considered. This updated bibliography contains 204 citations of which 44 are new entries to the previous edition. (Author's abstract)
W89-12142

DEEP WELL DISPOSAL, JANUARY 1977-MAY 1988: CITATIONS FROM THE SELECTED WATER RESOURCES ABSTRACTS DATABASE.
National Technical Information Service, Springfield, VA.
Available from National Technical Information Service, Springfield, VA 22161 as PB88-863857, Price codes: N01 in paper copy, N01 in microfiche. May 1988. 61p. Supersedes PB83-864058.

Descriptors: *Disposal wells, *Hazardous materials, *Bibliographies, *Underground waste disposal, *Deep wells, Model studies, Computer models, Wastewater disposal.

This bibliography contains citations concerning the disposal of liquid toxic wastes in injection or deep wells. Disposal by gravity flow and pressure flow are considered. Computer modelling to assess effectiveness of deep well disposal as well as disposal methods are examined. The economic and technical problems associated with deep well disposal are also considered. This updated bibliography contains 149 citations of which 19 are new entries to the previous edition. (Author's abstract)
W89-12147

SANITARY LANDFALLS, JANUARY 1978-APRIL 1988: CITATIONS FROM THE NTIS BIBLIOGRAPHIC DATABASE.
National Technical Information Service, Springfield, VA.
For primary bibliographic entry see Field 5B.
W89-12150

DEEP WELL DISPOSAL, JANUARY 1976-MARCH 1988: CITATIONS FROM THE ENERGY DATA BASE.
National Technical Information Service, Springfield, VA.
Available from National Technical Information Service, Springfield, VA 22161 as PB88-860960, Price codes: N01 in paper copy, N01 in microfiche. March 1988. 123p. Supersedes PB86-876729.

Descriptors: *Disposal wells, *Hazardous materials, *Bibliographies, *Underground waste disposal, *Deep wells, Radioactive waste disposal, Chemical wastes, Regulations, Path of pollutants, Waste management.

This bibliography contains citations concerning deep well disposal technology, including deep geologic, deep rock, and deep shaft repositories. Waste disposals treated are radioactive, chemical and geopressured. Regulations, environmental protection, risk and safety analysis, fluid and radionuclide migration are discussed. Research work on microbial decomposition of organic waste in deep wells is mentioned. This updated bibliography contains 357 citations of which 93 are new entries to the previous edition. (Author's abstract)
W89-12155

SEWAGE SLUDGE PRETREATMENT AND DISPOSAL, DECEMBER 1981-FEBRUARY 1988: CITATIONS FROM THE NTIS BIBLIOGRAPHIC DATABASE.
National Technical Information Service, Springfield, VA.
For primary bibliographic entry see Field 5D.
W89-12159

SLUDGE DEWATERING: SEWAGE AND INDUSTRIAL WASTES, JANUARY 1978-JANUARY 1988: CITATIONS FROM THE POLLUTION ABSTRACTS DATABASE.
National Technical Information Service, Springfield, VA.
Available from National Technical Information Service, Springfield, VA 22161 as PB88-857586, Price codes: N01 in paper copy, N01 in microfiche. February 1988. 59p. Supersedes PB85-860732.

Descriptors: *Wastewater treatment, *Sludge drying, *Bibliographies, *Sludge disposal, Wastewater treatment, Municipal wastes, Industrial wastes, Mine wastes.

This bibliography contains citations concerning techniques and equipment used in sewage, and industrial, mining, petroleum and municipal waste sludge dewatering. Dewatering processes, device design, and performance evaluations are considered. This updated bibliography contains 233 citations of which 51 are new entries to the previous edition. (Author's abstract)
W89-12168

5F. Water Treatment and Quality Alteration

LEGIONELLA AND PUBLIC WATER SUPPLIES.
Thames Water Authority, London (England). Regional Lab. Services.
For primary bibliographic entry see Field 5A.
W89-11070

BACTERIAL TRANSPORT IN FRACTURED ROCK: A FIELD-SCALE TRACER TEST AT THE CHALK RIVER NUCLEAR LABORATORIES.
Atomic Energy of Canada Ltd., Chalk River (Ontario). Chalk River Nuclear Labs.
For primary bibliographic entry see Field 5B.
W89-11080

DRINKING WATER MICROBIOLOGY RESEARCH IN THE UNITED STATES: AN OVERVIEW OF THE PAST DECADE.
Environmental Protection Agency, Cincinnati, OH. Drinking Water Research Div.
D. J. Reasoner.
Water Science and Technology WSTED4, Vol. 20, No. 11/12, p 101-107, 1988. 49 ref.

Descriptors: *Microbiological studies, *Reviews, *Water conveyance, *Water treatment, *Drinking water, *Potable water, Water quality, Water quality control, Human pathogens, Water quality standards, Water law, Legislation, Administrative regulations, Protozoa, Coliforms, Viruses, Bacteria, Turbidity, Heterotrophic bacteria, Giardia.

The passage of the Safe Drinking Water Act in 1974 significantly influenced microbiological, chemical and engineering research on drinking water quality in the United States. Microbiological quality research during the past 10 years encompassed the two basic areas of treatment and distribution. Much of the treatment research focused on generation of data to support the evaluation of

turbidity and coliform maximum contaminant levels (MCLs) for the Interim Primary Drinking Water Standards. Major efforts were also directed toward disinfection, research on enteric viruses, pathogenic bacteria and the protozoan pathogen, Giardia lamblia. Basic distribution system studies examined the occurrence of heterotrophic bacterial numbers and types in treated and untreated distribution waters, and coliform occurrence and colonization problems. Methodology developments bridged both treatment and distribution, and included enteric virus detection methods, injured coliform recovery, heterotrophic bacteria enumeration, and giardia cyst detection. Knowledge gained from the research efforts of the past decade has resulted in new challenges and opportunities to improve drinking water quality. (Author's abstract)
W89-11083

BIOFILM GROWTH IN A DRINKING WATER NETWORK: A PRELIMINARY INDUSTRIAL PILOT-PLANT EXPERIMENT.
Stelor Research Group, Nancy (France).
K. Haudidier, J. L. Paquin, T. Francais, P. Hartemann, and G. Grapin.
Water Science and Technology WSTED4, Vol. 20, No. 11/12, p 109-155, 1988. 5 fig, 4 tab, 14 ref.

Descriptors: *Biofilms, *Water conveyance, *Drinking water, *Bacterial analysis, *Water analysis, *Growth rates, Pilot plants, Path of pollutants, Biomass, Bacteria, Water transport, Pipelines, Population dynamics.

Bacterial populations (measured as total, actively respiring and plate count) were analyzed during drinking water transport within an industrial network pilot plant comprised of six serial loops. PVC and circular cement test tiles were exposed to the water flow using special sampling devices that allow location of the exposed surface of the tested tiles flush with the internal pipe wall. In the absence of any residual chlorine, bacterial growth was rapid (doubling time 10 h) during the first 40 h. Beyond that plateau, a stationary and even a decline phase were observed. Fixed biomass was around 10,000,000 bacteria/sq cm and decreased constantly with the distance from the feed point of the network. Substrate availability controls biofilm formation. (Author's abstract)
W89-11084

MULTIPLICATION OF A KLEBSIELLA PNEUMONIAE STRAIN IN WATER AT LOW CONCENTRATIONS OF SUBSTRATES.
Keuringsinstituut voor Waterleidingartikelen, Rijswijk (Netherlands).
For primary bibliographic entry see Field 5A.
W89-11085

MECHANISMS OF BACTERIAL SURVIVAL IN CHLORINATED DRINKING WATER.
American Water Works Service Co., Inc., Belleville, IL. Belleville Lab.
M. W. LeChevallier, C. D. Cawthon, and R. G. Lee.
Water Science and Technology WSTED4, Vol. 20, No. 11/12, p 145-151, 1988. 3 fig, 1 tab, 26 ref.

Descriptors: *Bacterial physiology, *Water treatment, *Drinking water, *Chlorination, *Disinfection, *Klebsiella, *Bacteria, Growth rates, Potable water, Survival, Microenvironment, Water conveyance, Path of pollutants, Water quality control.

Experiments showed that attachment of bacteria to surfaces provided the greatest increase in disinfection resistance. Attachment of high nutrient grown, unencapsulated, Klebsiella pneumoniae to glass microscope slides afforded the microorganism as much as a 150-fold increase in disinfection resistance. Other mechanisms that increased disinfection resistance included: the age of the biofilm, bacterial encapsulation and previous growth conditions (e.g. growth medium, and growth temperature). These factors increased chlorine resistance from two to tenfold. The choice of disinfectant residual was shown to influence the type of resistance mechanism observed. Disinfection by free chlorine was affected by surfaces, age of the biofilm, encapsulation and nutrient effects. Disinfection by monochloramine, however, was only affected by surfaces. Importantly, the research showed that these resistance mechanisms were multiplicative (e.g. the resistance provided by one mechanism could be multiplied by the resistance provided by a second). These results provide important insights to understand the survival of bacteria in chlorinated drinking water supplies. (Author's abstract)
W89-11089

KINETICS OF METHANE-OXIDIZING BIOFILMS FOR DEGRADATION OF TOXIC ORGANICS.
Washington Univ., Seattle. Coll. of Forest Resources.
For primary bibliographic entry see Field 5B.
W89-11092

INSTRUMENTAL DETECTION OF COLIFORM BACTERIA FOR INDUSTRIAL CONTROL OF DRINKING WATER QUALITY.
Societe Generale pour l'Agriculture, Rueil-Malmaison (France).
For primary bibliographic entry see Field 5A.
W89-11095

MICROBIAL POPULATION DISTRIBUTIONS AND BENZOATE MINERALIZATION KINETICS IN A MUNICIPAL SLOW SAND FILTER.
New Hampshire Univ., Durham. Dept. of Civil Engineering.
T. T. Eighmy, M. R. Collins, S. K. Spanos, and J. Fenstermacher.
Water Science and Technology WSTED4, Vol. 20, No. 11/12, p 293-299, 1988. 4 fig, 1 tab, 38 ref. American Water Works Research Foundation Contract 208-86.

Descriptors: *Benzoates, *Municipal water, *Water treatment, *Biodegradation, *Microbial degradation, *Sand filters, *Mineralization, Growth kinetics, Microenvironment, Heavy metals, Substrates, Iron, Kinetics, Microorganisms, Manganese, Distribution pattern.

The microbial populations within the media of a slow sand filter were evaluated with regard to distribution and activity. Cores from the filter were used to quantify and depth acriflavine direct cell counts (AFDC) using epifluorescence microscopy, nutritionally specific heterotrophs (R2A), aquatic organic matter (AOM) utilizers, benzoate utilizers, catechol utilizers, heterotrophic iron precipitators, and manganese oxidizers using various spread plate techniques. Extractable Fe and Mn, as well as Folin-reactive material (FRM) were quantified with depth. The ability of schmutzdecke ('mud-blanket') populations to mineralize (U-14C) benzoate was also examined. AFDC counts revealed that the schmutzdecke contained the highest counts (10 to the 9th and 10 to the 10th power/g dry wt) with counts declining by one to two orders of magnitude with depth in the filter media. All nutritionally specific plate counts exhibited similar trends with depth; R2A plate counts were generally less than 1% of the AFCD. AOM, benzoate, and catechol utilizers were more prevalent in the schmutzdecke (as a percentage of the AFDC) than with depth in the cores. Small, opaque-white colonies were observed on the AOM benzoate, and catechol media, suggesting the same bacterium (small flagellated rod) was responsible for growth on the three media. FRM correlated well with the AFDC with depth; the data suggests that the Folin reagent complexed with bacterial aromatic amino acids and was thus a good measure of microbial biomass. Extractable Fe and Mn correlated with AFDC, FRM, and with heterotrophic Fe precipitator and Mn oxidizer plate counts. All schmutzdecke samples were able to rapidly mineralize benzoate in the 1.0 to 1000 ng/ml range. The data suggest that while non-purgeable dissolved organic carbon (NPDOC) removals are low, the microbial populations present in the filter are capable of promoting bioadsorption and biodegradation of certain fractions of the AOM in the raw water during winter operation. (Author's abstract)
W89-11110

INACTIVATION OF HEPATITIS A VIRUS AND MODEL VIRUSES IN WATER BY FREE CHLORINE AND MONOCHLORAMINE.
North Carolina Univ. at Chapel Hill. Dept. of Environmental Sciences and Engineering.
For primary bibliographic entry see Field 5D.
W89-11122

F-SPECIFIC RNA-BACTERIOPHAGES AS MODEL VIRUSES IN WATER HYGIENE: ECOLOGICAL ASPECTS.
Rijksinstituut voor de Volksgezondheid en Milieuhygiene, Bilthoven (Netherlands). Lab. for Water and Food Microbiology.
For primary bibliographic entry see Field 5A.
W89-11124

EVALUATION OF HEALTH RISK ASSOCIATED WITH DRINKING WATER QUALITY IN AGRICULTURAL COMMUNITIES.
Hebrew Univ. of Jerusalem (Israel). Graduate School of Applie Science and Technology.
B. Fattal, N. Guttman-Bass, T. Agursky, and H. I. Shuval.
Water Science and Technology WSTED4, Vol. 20, No. 11/12, p 409-415, 1988. 6 tab, 10 ref.

Descriptors: *Risk assessment, *Epidemiology, *Water quality, *Drinking water, *Public health, *Population exposure, *Farms, Enteroviruses, Pathogens, Water analysis, Sampling, Coliforms, Morbidity, Israel, Human diseases.

The association of enteric disease morbidity, enteric outbreaks and prevalence of antibodies for enteroviruses, with the level of conventional microbial drinking-water indicators, was tested for drinking water in agricultural communities in Israel. The study was based on a prospective seroepidemiological study of disease transmission associated with land application of wastewater in these communities conducted from March 1981 to February 1982. Population, morbidity, serologic and enteric data was culled from surveys and patient files. A total of 300 drinking water samples were drawn and assayed with membrane filtration. Results of the data analysis indicate that there was no association between drinking water quality (total or fecal coliforms) and enteric morbidity, despite the fact that in the low quality drinking water category, there was a high percentage of months (mean of 85 percent, ranging from 67-100 percent), in which fecal coliform counts were above standard level. Possible explanations for this lack of association include the fact that enteric disease is highly endemic in the agricultural centers (kibbutzim) due to such factors as common dining facilities for the whole community and common infant and child care facilities; these leads to possible concurrent multiple routes of infection. Also, current microbial water quality standards provide a sufficient margin of safety so that the generally small deviations between the high and low quality water supplies were not sufficient to result in excess enteric disease. (Friedmann-PTT)
W89-11125

RAPID NITROCELLULOSE ENZYME IMMUNOSORBENT ASSAY TECHNIQUE (NCEIA) FOR MONITORING VIRUSES IN THE ENVIRONMENT,
Hawaii Univ., Honolulu. Dept. of Microbiology.
For primary bibliographic entry see Field 5A.
W89-11127

APPLYING BACTERIOLOGICAL PARAMETERS FOR EVALUATING UNDERGROUND WATER QUALITY.
National Research Centre, Cairo (Egypt). Water Pollution Control Lab.
For primary bibliographic entry see Field 5A.
W89-11128

AFTERGROWTHS IN DRINKING WATER SYSTEMS: AN AUSTRALIAN PERSPECTIVE.
New South Wales Univ., Kensington (Australia). Dept. of Microbiology.
K. Power, B. Cooper, H. Watts, and L. A. Nagy.
Water Science and Technology WSTED4, Vol. 20, No. 11/12, p 437-439, 1988. 1 fig, 2 ref.

Descriptors: *Water conveyance, *Drinking water, *Australia, Coliforms, Water analysis, Microorganisms, Bacteria, Potable water, Urban areas, Monitoring.

Aftergrowths in drinking water distribution systems were investigated in Sydney, Australia. The microbiological monitoring results, collected over a 2-yr period, were used to provide information on interactions between various parameters. Results indicated that microorganisms and total coliforms were usually absent in waters with total chlorine levels over 0.2 mg/L. Results also indicated inhibition between plate count organisms (at 20 and 35 C), and total coliforms, particularly once plate count levels exceeded 100 CFU/ml. In terms of aftergrowths, the Sydney system appeared to be similar to other water distribution systems in large urban areas with a moderate to warm climate. (Author's abstract)
W89-11131

NITRIFYING BACTERIA IN A CHLORAMINATED DRINKING WATER SYSTEM.
Southern California Metropolitan Water District, La Verne. Water Quality Branch.
N. R. Ike, R. L. Wolfe, and E. G. Means.
Water Science and Technology WSTED4, Vol. 20, No. 11/12, p 441-444, 1988. 1 fig, 1 tab, 2 ref.

Descriptors: *Nitrogen fixing bacteria, *Chloramines, *Bacterial analysis, *Water conveyance, *Drinking water, *Pollutant identification, Water analysis, Nitrification, Water pollution, Microenvironment, Bacteria, Seasonal variation, Temperature effects, Microorganisms, Water quality, Potable water, Reservoirs.

As a result of a nitrification episode in the Orange County Reservoir, a covered, finished-water reservoir, the Metropolitan Water District of Southern California monitored the occurrence of ammonia-oxidizing bacteria (AOB) and studied the ecology of these bacteria in this reservoir. Results showed that AOB ranged from < 0.18 most probable number (MPN)/ml in the winter months to 500 MPN/ml during a nitrification episode in the summer. Significant relationships were observed between the numbers of AOB and temperature, heterotrophic plate count and nitrite. Additional analysis within the reservoir indicated that high numbers of AOB predominated in the bottom sediment, which may provide a protective environment for their survival and growth. (Author's abstract)
W89-11132

COMPARISON OF VIRUS SURVIVAL IN FRESHWATER SOURCES.
Arizona Univ., Tucson. Dept. of Nutrition and Food Science.
S. M. Kutz, and C. P. Gerba.
Water Science and Technology WSTED4, Vol. 20, No. 11/12, p 467-471, 1988. 1 fig, 2 tab, 13 ref.

Descriptors: *Water treatment, *Fate of pollutants, *Path of pollutants, *Enteroviruses, *Pathogens, *Water pollution sources, *Temperature effects, Viruses, Public health, Human diseases, Statistical analysis, Potable water, Survival, Comparison studies.

Enteric viruses are a potential cause of human gastroenteritis. Their ability to cause waterborne disease may be attributed to their low infectious dose and survival for prolonged periods of time in aquatic environments. Virus survival studies have shown temperature to be a major factor in determination of inactivation rates. Literature on virus inactivation rates at various temperatures was compiled for freshwater sources including ground, tap, river, and impounded water. Data were grouped according to either virus type or water source. Linear regression and analysis of variance were used to evaluate the significance of temperature on virus survival. Data were also analyzed to obtain a general line of best fit for virus inactivation at various temperatures. Temperature was found to be a significant factor in virus inactivation. However, significance of the effect of temperature varied with virus type and water source. Approximately 3 to 99 percent of variation in virus inactivation rates can be explained by temperature. The slowest inactivation rate obtained was for coliphage in groundwater. Inactivation rates for virus in tap water were among the highest and the overall mean inactivation rate for all virus data was slightly greater than 0.5 log/day. Future comparisons of the effect of temperature as well as other environmental factors on virus survival may require the development of standard methods for virus inactivation studies. (Author's abstract)
W89-11139

EVALUATION OF THE NH4-N AND DOC REMOVAL EFFICIENCY BY SUBMERGED BIOFILM PROCESS IN TAP WATER SUPPLY PRETREATMENT SYSTEM.
Tohoku Univ., Sendai (Japan). Dept. of Civil Engineering.
M. Takasaki, M. Harada, and A. Sato.
Water Science and Technology WSTED4, Vol. 20, No. 11/12, p 517-519, 1988. 5 fig.

Descriptors: *Water treatment, *Ammonia, *Pretreatment of water, *Potable water, *Disinfection, Water quality control, Raw water, Water supply, Water quality, Water treatment, Chlorination, Biofilms, Oxidation, Organic carbon, Dissolved solids.

Ammonia (NH4) is the most significant pollutant of water supply sources because it hinders the disinfection and oxidation effects of chlorine used for purification. It is essential to reduce the chlorine dosage required for purification, which requires elimination of NH4 in raw water. A significant condition for the submerged biofilm process of tap water compared to sewage treatment is the raw water quality. There are some factors other than NH4 oxidation rate that determine the process performance. Thus, a study was conducted to estimate the performance of a submerged biofilm observed in lakes and marshes processing polluted raw water. Two reactors, composed of transparent vinyl chloride and filled with filter medium called 'honeycomb tube,' treated raw water for the study. Biofilm process performance was estimated in advance. Results showed that under adverse circumstances of low temperature (5 to 11 C) from winter to spring, the biofilm NH4 removal ratio was indicated as 60-80 percent. However, during this period, processed water was observed to contain a little more NH4 than raw water, when the NH4 concentration in raw water is 0.1 mg/l or less. Compared to NH4, the removal ratio of total organic carbon was low, zero for dissolved organic carbon (DOC). (Friedmann-PTT)
W89-11151

BACTERIAL GROWTH IN WATER DISTRIBUTION SYSTEMS.
Montana State Univ., Bozeman. Inst. for Biological and Chemical Process Analysis.
E. van der Wende, W. G. Characklis, and J. Grochowski.
Water Science and Technology WSTED4, Vol. 20, No. 11/12, p , 1988. 2 fig.

Descriptors: *Bacteria, *Path of pollutants, *Water conveyance, *Drinking water, *Growth rates, Water supply, Substrates, Plankton, Mathematical studies, Sampling, Microorganisms, Potable water.

A study was conducted to quantify the contribution of detached biofilm cells and to the replication of planktonic cells to the total planktonic cell concentration in drinking water, to determine if biofilm growth is significant to regrowth, and to determine the effect of low concentrations of chlorine on biofilm accumulation and bacteriological water quality. The experiment was conducted using a newly developed RotoTorque System consisting of four reactors in series. The four reactors serve as 'windows' for the collection of water and biofilm samples. For the chlorine tests, chlorine was added to the influent in a mixed feed tank prior to the reactor. Biofilm samples were collected by means of a vacuum technique. A mathematical expression was used to determine biofilm and planktonic growth rates. Results showed that most microbial growth occurred in the first reactor and specific growth rate of the biofilm cells was calculated at 0.06/day for a turnover time of about 17 days. The specific growth rate of the planktonic cells in this reactor was -2.9/day. The numbers of suspended cells increased in proportion to biofilm cell numbers while they reached approximately the same levels as in the chlorine-free system. (Friedmann-PTT)
W89-11152

EDUCATING THE RURAL PUBLIC ABOUT SAFE DRINKING WATER.
Ohio State Univ., Columbus. Dept. of Agricultural Engineering.
K. Mancl, W. Sharpe, and J. Makuch.
Water Resources Bulletin WARBAQ, Vol. 25, No. 1, p 155-158, February 1989. 1 tab, 4 ref.

Descriptors: *Drinking water, *Water quality, *Rural areas, *Education, Surveys.

From 1984-87, the Penn State Cooperative Extension Service conducted 40 safe water clinics for more than 3000 rural homeowners. The clinics were developed to provide homeowners and farmers with information on managing their private water supplies. Four of the clinics were evaluated using a mail survey. By using a four part mailing, response rates of 63-77% were achieved. Based on the evaluation results of the four clinics, 11 of the 14 objectives dealing with information value, knowledge gained, and actions taken were met. (Author's abstract)
W89-11171

MANGANESE OXIDATION RELATED TO THE RELEASES FROM RESERVOIRS.
Tennessee Technological Univ., Cookeville. Dept. of Civil Engineering.
For primary bibliographic entry see Field 5B.
W89-11175

VIRUS REMOVAL BY DRINKING WATER TREATMENT PROCESSES.
Institut Armand-Frappier, Laval (Quebec). Centre de Recherche en Virologie.
P. Payment, and R. Armon.
CRC Critical Reviews in Environmental Control CCECAU, Vol. 19, No. 1, p , 1989. 6 tab, 85 ref.

Descriptors: *Limnology, *Water treatment, *Wastewater treatment, *Drinking water, *Literature review, *Viruses, *Disinfection, Ozonation, Chlorination, Filtration, Epidemiology, Policy making, Water quality standards.

The occurrence, detection, and elimination of viruses in drinking water are reviewed. While viruses are excreted in large numbers in the feces of infected individuals, the low incidence of infection in a population and the dilution factor after their release in the water accounts for low numbers in contaminated surface waters. When these waters are abstracted for the preparation of drinking water, the level of viral contamination will be decreased dramatically by water treatment. To detect such low viral densities in water, methods have been developed to concentrate viruses from large volumes of water, volumes as large as several thousand liters of drinking water. These methods permit the precise study of virus elimination and distribution under actual plant operation. This review addresses data reported in the literature since 1980 and from groups that have used methods significantly precise to permit meaningful assessment of the data reported. However, we still know very little of the survival of viruses during treatment processes in the field. Our methods, while much more refined than they were, are still limited to the detection of a limited number of viruses. As we will more frequently use the recently developed methods such as immunoperoxidase

and gene probes for the detection of the non-cytopathogenic and non-culturable viruses, we will certainly gather new insight on virus removal during drinking water and wastewater treatment. The current studies are focusing on the health effects of a small number of microorganisms and should enable a better appreciation of the health effects, if any, of the presence of viruses, as well as the opportunistic bacteria in drinking water. These studies, if linked to the evaluation of current and new indicators of water quality, should generate enough information to enable the policy makers to elaborate meaningful standards of water quality. (Sand-PTT)
W89-11198

COST-EFFECTIVENESS OF SOLAR WATER PRODUCTION.
Kuwait Inst. for Scientific Research, Safat.
For primary bibliographic entry see Field 3A.
W89-11203

ENERGY CONSERVATION AT GNFC.
Gujarat Narmada Valley Fertilizers Co. Ltd., Broach (India).
V. K. Karia, and R. K. Khamker.
Water Science and Technology WSTED4, Vol. 20, No. 10, p 75-82, 1988. 3 fig, 1 tab.

Descriptors: *Energy, *Conservation, *Fertilizers, *Ammonia, *Water treatment, Agricultural chemicals, India, Ureas, Boiler water, Cooling towers, Demineralization, Sodium hydroxide, Steam, Compressed air, Condensates.

The conservation and recovery of energy have been given a very high priority at the Gujarat Narmada Valley Fertilizers Company Limited (GNFC), which owns the world's largest single stream ammonia and urea plants. Even smaller plants of the GNFC complex, such as the utilities section, are included in the energy conservation program. After commissioning of the plants, a systematic study was made to identify those areas where the energy input could be reduced. A number of steps were taken, such as trimming pump impellers, synchronizing timings of the operation of extra machinery with load needs, improving the quality of chemicals and the boiler feedwater, reducing losses of compressed air, etc. As a result, the costs of energy inputs were reduced by nearly 25% in the utility plant, and 15% in the ammonia plant. (Author's abstract)
W89-11226

QUANTITATION OF INTERFERENCES UNDER EQUILIBRIUM CONDITIONS WITH APPLICATION TO FREE CHLORINE ANALYSIS IN THE PRESENCE OF ORGANIC CHLORAMINES.
North Carolina Univ., Chapel Hill. School of Public Health.
For primary bibliographic entry see Field 7B.
W89-11301

EFFECT OF WATER TREATMENT ON THE LEVELS OF CHLORINATED ORGANICS AT DIFFERENT WATER STATIONS IN THE VICINITY OF ALEXANDRIA, EGYPT.
Alexandria Univ. (Egypt). Lab. of Environmental Chemistry and Toxicology.
For primary bibliographic entry see Field 5B.
W89-11360

BUYING TOMORROW'S WATER.
For primary bibliographic entry see Field 6C.
W89-11458

MEMBRANES IN WATER TREATMENT.
Montgomery (James M.) Consulting Engineers, Inc., Pasadena, CA. Montgomery Labs.
J. G. Jacangelo, N. L. Patania, and R. R. Trussell.
Civil Engineering CEWRA9, Vol. 59, No. 5, p 68-71, May 1989.

Descriptors: *Water treatment, *Membrane filters, *Membrane processes, *Reverse osmosis, Economic aspects, Nanofiltration, Electrodialysis, Economic aspects, Potable water.

Membrane technology is a promising alternative to conventional water treatment for removing turbidity, bacteria and other microorganisms, and the organic compounds responsible for color and trihalomethane formation. Currently, reverse osmosis, nanofiltration and electrodialysis are the membrane processes with the most applicability for potable water treatment. The most important operating parameters in membrane processes are flux, operating pressure, recovery, and product water quality. Specific membrane water treatment applications depend on the water source quality. In the U.S., membrane systems totaling approximately 50 mgd of water treatment capacity have been installed over the past two decades. Membranes offer the advantage of limiting the amount of chemicals needed for water purification, producing a water of superior quality, limiting plant size, reducing operation and maintenance costs, and reducing costs associated with sludge dewatering, handling and disposal. The relative costs associated with membrane technology have traditionally slowed its use. Before this technology can be used widely, further advances need to be made in membrane performance. (White-Reimer-PTT)
W89-11460

HOME SHOWER-BATH PSEUDOMONAS FOLLICULITIS.
Rogoff-Wellcome Medical Research Inst., Petach Tikva (Israel). Dept. of Internal Medicine.
For primary bibliographic entry see Field 5C.
W89-11462

RESINS FOR HIGH-PURITY WATER PRODUCTION.
Central Electricity Generating Board, Ratcliffe-on-Soar (England). Operational Engineering Div.
M. Ball, and R. R. Harries.
Journal of Chemical Technology and Biotechnology JCTBDH, Vol. 45, No. 2, p 97-107, 1989. 2 fig, 4 tab, 8 ref.

Descriptors: *Water treatment, *Feedwater treatment, *Boiler water, *Resins, *Ion exchange, Exchange capacity, Cation exchange, Anion exchange, Sulfates, Organic matter, Mass transfer.

In plants for the production of feedwater for high-pressure boilers, it is important to specify appropriate parameters for the ion exchange resins used. The parameters proposed for all make-up plant resins are total exchange capacity, bead integrity and physical strength (resistance to osmotic shock and attrition), supplemented by maximum, minimum and harmonic mean bead sizes appropriate for use in cation exchange, anion exchange and mixed bed units. For condensate purification plant resins, total exchange capacity, bead integrity, physical strength and bead size are again specified, with tighter limits for resistance to osmotic shock and attrition, to reduce the risk of physical breakdown in service. Bead densities should be included and closer bead size distributions to ensure good overall kinetics for cation and anion exchange, while maintaining hood separation on backwashing. A minimum mass transfer coefficient is also required to ensure adequate anion exchange kinetics for sulfate at the typical condensate purification plant linear flow rate of 100 m/h. Consideration should be given to specifying the maximum organic matter that may be released by new resins in contact with water in an endeavor to limit the amount of deleterious chemical compounds produced in manufacturing that can be released into the treated water. (Author's abstract)
W89-11466

OZONE DISINFECTION IN DRINKING WATER.
Compagnie Generale des Eaux, Paris (France). Centre de Recherche.
M. M. Bourbigot.
Journal of the New England Water Works Association JNEWA6, Vol. 103, No. 1, p 1-11, March 1989. 1 fig, 5 tab, 15 ref.

Descriptors: *Drinking water, *Ozonation, Disinfection, Pathogenic bacteria, Viruses, Microorganisms, Acanthamoebae, Temperature, Protozoa.

Ozone has been used to disinfect the drinking water of Nice for 82 years and throughout the world, 15 million cubic meters of water are ozonated every day. The principle of 'true ozonation', established by Coin and Gomella in 1964, is applied at major water treatment facilities for virus inactivation and is also efficient for inactivation of most amoebae and giardia cysts (ensuring a safety margin in most cases). This 'true ozonation' is obtained when the water is ozonated at a level of 0.4 mg/L, maintained for a period of 4 minutes (charge transfer value = 1.6 mg/L/mn). Only the fairly resistant microorganisms such as Acanthamoebae strains require the use of higher C.T. (charge transfer) values. The temperature has an effect on disinfection. The inactivation rate decreases with a decrease in temperature and in cold conditions the C.T. value should be increased. For inactivation of protozoan cysts, ozone is far more efficient than chlorine, chloramine or chlorine dioxide. (Author's abstract)
W89-11476

GENETIC TYPING IN A CLUSTER OF LEGIONELLA PNEUMOPHILA INFECTIONS.
Amsterdam Univ. (Netherlands). Dept. of Medical Microbiology.
For primary bibliographic entry see Field 5B.
W89-11503

IODINE SENSITIVITY OF BACTERIA ISOLATED FROM IODINATED WATER SYSTEMS.
Montana State Univ., Bozeman. Dept. of Microbiology.
B. H. Pyle, and G. A. McFeters.
Canadian Journal of Microbiology CJMIAZ, Vol. 35, No. 4, p 520-523, April 1989. 1 fig, 1 tab, 22 ref.
NASA Contract NAS 9-17346.

Descriptors: *Iodine, *Disinfection, *Bacteria, *Water treatment, Anion exchange, Culturing techniques, Pseudomonas, Growth, Phosphates.

Fourteen bacterial isolates, predominantly Pseudomonas sp., from two water systems disinfected by iodinated anion-exchange resins, were studied and compared with an isolate of Pseudomonas aeruginosa from a povidone-iodine solution and four other isolates. Pseudomonas cepacia and P. aeruginosa grown in brain heart infusion were 3 to 5 logs less sensitive to 1 mg/L I2 (pH 7.2, 1 min) when compared with cultures grown in phosphate buffer. Another P. cepacia isolate was the least sensitive culture when grown in brain heart infusion (1 log decrease) but was more sensitive after cultivation in phosphate buffer (5 logs). Isolates from an iodinated potable water system, including P. cepacia, Staphylococcus warneri, and a Bacillus sp., were all less sensitive to iodine than a 'resistant' P. aeruginosa and three other isolates when grown in brain heart infusion. A clinical isolate of P. aeruginosa exhibited intermediate sensitivity. The sensitivity of bacteria to iodine is thus highly variable, depending on the organism as well as the growth conditions. (Author's abstract)
W89-11507

SURVIVAL OF CHLORINE-INJURED ENTEROTOXIGENIC ESCHERICHIA COLI IN AN IN VITRO WATER SYSTEM.
West Virginia Univ., Morgantown. Div. of Plant and Soil Sciences.
S. M. Walsh, and G. K. Bissonnette.
Applied and Environmental Microbiology AEMIDF, Vol. 55, No. 5, p 1298-1300, May 1989. 3 fig, 6 ref.

Descriptors: *Human diseases, *Survival, *Disinfection, *Escherichia coli, *Chlorination, *Water treatment, Phosphates, Drinking water, Microbiological studies, Bioindicators.

Survival of chlorine-injured and noninjured subpopulations of enterotoxigenic Escherichia coli was

compared in KH2-PO4-buffered water and chlorine-neutralized tap water. Injured cells were no less persistent than noninjured cells and did not exhibit limited survival as a consequence of chlorine injury. At high inoculum densities, some injured cells were able to repair, apparently owing to the accumulation of materials arising from the chlorination procedure. Results show that repair is possible in low-nutrient, aquatic environments which support minimal allochthonous growth. These findings raise new questions concerning the role of nutrients in initiation of the repair process and the health risks associated with chlorine-injured pathogens in aquatic environments. In addition, it may be of some significance that multiplication of enteropathogens can occur when supported by materials released from damaged cells after the chlorination procedure. These experiments further demonstrate that injured cells can persist as such in the environment and exhibit survival characteristics similar to noninjured cells. In view of these findings and the potential for in vivo repair, the use of extraordinary methodologies directed towards recovery of injured indicator organisms from chlorinated environments appears to be justified. (Author's abstract)
W89-11513

KANSAS CITY UPGRADES WATER PLANT.
Kansas City Water Pollution Control Dept., MO.
F. Pogge, F. Shorney, and B. Zion.
Water Engineering and Management WENMD2, Vol. 136, No. 5, p 30-32, May 1989. 2 fig.

Descriptors: *Water treatment facilities, *Kansas City, Maintenance, Costs, Economic aspects, Renovation, Pumping plants, Water conveyance.

As part of their commitment to keep facilities in reliable service, the city has spent over $8 million in the last five years to upgrade. Recently, a $110 million revenue bond package for water system improvements was passed which includes $22 million for rehabilitation work at the water plant. Two buried, reinforced concrete vaults, enclosing 30-, 48-, and 60-inch diameter header piping and isolation valves for the plant pump station, are being renovated. Improving access during renovation improvements is a secondary objective of the vault rehabilitation. Because of the importance of the two vaults, rehabilitation for long-term use is being pursued as a general objective instead of making only minimum repairs as necessary. In another recent project, the city installed a natural-gas engine-driven vertical turbine pump in the plant pump station to serve the north Kansas City system. With the completion of improvements, the city envisions continued use of the existing water-treatment plant well into the 21st century. (White-Reimer-PTT)
W89-11630

WATER PLANT OPTIMIZES COAGULANT DOSAGES.
Texas Univ. at El Paso. Dept. of Civil Engineering.
A. J. Tarquin, D. Tsimis, and D. Rittman.
Water Engineering and Management WENMD2, Vol. 136, No. 5, p 43-47, May 1989. 2 fig, 1 tab.

Descriptors: *Water treatment, *Chemical coagulation, *Texas, Economic aspects, Operating costs, Cost analysis, Regression analysis, Optimization, Turbidity, Backwash.

The results of this study were used to determine the coagulant dosage producing the lowest total cost when the coagulation, sedimentation and filtration processes were considered together for the Robertson Water treatment Plant-1 in El Paso, Texas. Plant operating data and laboratory jar tests were used to determine the relationship between settled water turbidity and chemical dosage. The total cost of treatment as a function of coagulant dosage was obtained by addition of the backwash water and coagulant costs. Using linear and polynomial regression analysis equations were derived for determining the relationship between coagulant dosage, settled water turbidity, and backwash water rates. At the time this research was conducted, the average coagulant dosage at the plant studied was 12 mg/L. By reducing the coagulant dosage by 50%, there is a 23% reduction in total cost between the two units. This 23% total cost reduction translates into a $25,620 cost saving. Additional savings may be possible if the backwash rate could be reduced through the use of appropriate polymers as coagulation and/or filter aids. (White-Reimer-PTT)
W89-11632

AIR STRIPPING REMOVES PETROLEUM FROM GROUNDWATER.
Agway, Inc., Syracuse, NY.
For primary bibliographic entry see Field 5G.
W89-11633

STUDIES OF DUAL-MEDIA FILTRATION OF THE TIGRIS RIVER USED FOR DRINKING WATER: MATHEMATICAL RELATIONSHIPS.
Mosul Univ. (Iraq). Saddam Dam Research Centre.
M. A. Al-Layla, M. Y. Al-Ani, and S. M. Rawi.
Journal of Environmental Science and Health (A) JESEDU, Vol. 24A, No. 2, p 99-110, February 1989. 1 fig, 6 tab, 10 ref.

Descriptors: *Filtration, *Drinking water, *Water treatment, *Iraq, Sand filters, Mathematical analysis, Turbidity, Water depth, Head loss, Particle size, Tigris River, Pilot plants, Statistical analysis.

The use of dual media rapid sand filtration for treating Tigris River raw water was considered. More than forty test runs employing different dual media filter configurations were conducted using a pilot plant that was designed to operate similarly to the full scale water treatment plant. Statistical analyses showed that the effect of increasing sand depth was about 2.5 times the effect of increasing headloss development for improving filter efficiency. The effect of increased influent turbidity on the degradation of the produced effluent was as much as 2.5 times the effect of filtration rate, 1.5 times that of sand size, and 4 times that of increasing anthracite depth. Several mathematical models were evaluated to describe relationships between effluent turbidity as a dependent variable and process variables. The equation that best fitted the data obtained was characterized by the highest number of replications and least mean square error. (White-Reimer-PTT)
W89-11639

UPTAKE OF MERCURY FROM AQUEOUS SOLUTION BY DUCKWEED: THE EFFECTS OF PH, COPPER AND HUMIC ACID.
Louisiana State Univ. System, Baton Rouge.
For primary bibliographic entry see Field 5D.
W89-11640

METAL CONTAMINATION OF DRINKING WATER FROM CORROSION OF DISTRIBUTION PIPES.
University of Petroleum and Minerals, Dhahran (Saudi Arabia). Water Resources and Environment Div.
For primary bibliographic entry see Field 5B.
W89-11651

ESTIMATING THE BURDEN OF ILLNESS IN AN ONTARIO COMMUNITY WITH UNTREATED DRINKING WATER AND SEWAGE DISPOSAL PROBLEMS.
McMaster Univ., Hamilton (Ontario). Dept. of Clinical Epidemiology and Biostatistics.
For primary bibliographic entry see Field 5C.
W89-11670

STUDY OF CONTACTING SYSTEMS IN WATER AND WASTEWATER DISINFECTION BY OZONE: I. MECHANISM OF OZONE TRANSFER AND INACTIVATION RELATED TO THE CONTACTING METHOD SELECTION,
Tsinghua Univ., Beijing (China). Dept. of Environmental Engineering.
For primary bibliographic entry see Field 5D.
W89-11687

STUDY OF CONTACTING SYSTEMS IN WATER AND WASTEWATER DISINFECTION BY OZONE: I. MATHEMATICAL MODELS OF THE OZONE DISINFECTION PROCESS WITH A STATIC MIXER,
Tsinghua Univ., Beijing (China). Dept. of Environmental Engineering.
For primary bibliographic entry see Field 5D.
W89-11688

DETERMINATION OF RESIDUAL OZONE OR CHLORINE DIOXIDE IN WATER WITH ACVK: AN UPDATED VERSION.
Compagnie Intercommunale Bruxelloise des Eaux (Belgium).
W. J. Masschelein, G. Fransolet, P. Laforge, and R. Savoir.
Ozone: Science and Engineering OZSEDS, Vol. 11, No. 2, p 209-215, 1989. 3 fig, 5 ref.

Descriptors: *Water treatment, *Disinfection, *Chemical analysis, *Dyes, *Ozone, *Chlorine dioxide, Reagents, Drinking water, Detection limits.

The analytical control of residual oxidants is necessary to operate water treatment plants. A sufficient residual concentration, after a given time, is used as a guarantee of correct disinfection. Also, the residual concentrations in the drinking water are important for the protection of the consumer. It is shown that determination of residual ozone or residual chlorine dioxide can be carried out with Acid Chrome Violet K (ACVK--C.I. code no. 61710, formerly 6170), now available as dye for analytical use under the name of Alizarin Violet 3R (Aldrich 22, 783-8; MW 622.25). The discoloration of the dye in and NH3-NH4Cl buffered solution of pH 8.1 to 8.5 is specific both for ozone and for chlorine dioxide without interference from chlorine, chloramines, chlorite or chlorate ions in concentrations possibly encountered in treated drinking water. The detection limit for ACVK was found to be 0.02 mg/L, standard deviation 0.01 mg/L, for both ozone and chlorine dioxide. (Author's abstract)
W89-11689

AMMONIA, NITRITE AND NITRATE NITROGEN REMOVAL FROM POLLUTED SOURCE WATER WITH OZONATION AND BAC PROCESSES.
Harbin Architectural and Civil Engineering Inst. (China). Water Pollution Control Research Center.
B. Wang, J. Tian, J. Yin, and G. Shi.
Ozone: Science and Engineering OZSEDS, Vol. 11, No. 2, p 227-244, 1989. 14 fig, 4 tab, 6 ref.

Descriptors: *Water treatment, *Wastewater treatment, *Ammonia, *Nitrites, *Nitrates, *Nitrogen removal, *Ozonation, *Activated carbon, Filtration, Sand filters, Flocculation, Pilot studies, Biological wastewater treatment, Heterotrophic bacteria, Nitrification, Dissolved oxygen, Hydrocarbons.

Studies on the removal of ammonia-, nitrite-, and nitrate nitrogen with ozonation (O3), sand filtration (SF), biological activated carbon (BAC), SF-BAC, and/or O3-BAC processes were carried out in two pilot plants and a full scale plant. The results showed that all of the tested processes exhibited certain nitrogen removal efficiencies; the O3-SF-BAC and O3-BAC processes were most effective and efficient in removing ammonia nitrogen, with mean removal efficiencies of some 90 and 80 percent. Ozonation was found able to oxidize some organic nitrogen into ammonia, and nitrite ion into nitrate ion. It was also discovered that O3-BAC process can carry nitrification to completion if there is sufficient dissolved oxygen. Some hydrocarbon substrates can be oxidized through ozonation so that they are more easily assimilated by strains of Nitrobacter that multiply heterotrophically in the carbon beds. In the BAC process without ozonation, both the DO and easily-assimilated-substrate levels were too low in the carbon beds to sustain Nitrobacter growth; but

nitrite-conversion bacteria, like Nitrosomonas, can survive under such conditions. As a result, nitrite or nitrate ion content was higher in the effluents from BAC or O3-BAC processes than in the influents. The removal mechanisms for the three forms of nitrogen were studied in various other processes. Ammonia nitrogen was removed quite well in both microflocculaton/direct filtration (MF/DF) and GAC (granular activated carbon) columns, of which the prepositioned MF/DF columns were responsible for a major portion of total ammonia removal, with a mean removal efficiency of 72 percent vs. 83 percent in total. Nitrite nitrogen was also removed efficiently in both the dual media and GAC beds. In contrast, nitrate nitrogen was removed negligibly, sometimes with negative removal efficiencies, due to nitrification taking place in GAC beds; the average nitrate nitrogen removal efficiency of GAC beds was only 8.5 percent. (Friedmann-PTT)
W89-11690

AQUEOUS OZONATION OF FATTY ACIDS.
Imperial Coll. of Science and Technology, London (England). Dept. of Civil Engineering.
G. Reynolds, C. Corless, N. Graham, R. Perry, and T. M. Gibson.
Ozone: Science and Engineering OZSEDS, Vol. 11, No. 2, p 143-154, 1989. 5 fig, 2 tab, 11 ref.

Descriptors: *Drinking water, *Water treatment, *Public health, *Risk assessment, *Ozonation, *Fatty acids, *Lipids, Chemical reactions, Chemical properties, Gas chromatography, Mass spectrometry, Ozone.

Concern over the potential hazard to human health of trihalomethanes (THMs) and other halogenated organics believed to be produced during chlorination of drinking water has led to the need to reevaluate the use of alternative disinfectants in potable water treatment. Ozone, at present widely used in Europe and increasingly in the USA, is a possible alternative to chlorine and has the advantage of eliminating or reducing THM formation when applied at its optimum dose. In addition, the rapid decomposition of ozone to oxygen creates little cause for concern, as regards the health effects of ozone or its degradation products. In contrast, the oxidation products resulting from the reaction of ozone with substances present in raw waters are potentially significant, although information on the nature of these products is inadequate. A systematic study is being conducted to investigate the reactivity of a large number of organic substances toward ozone. The reactivity of a series of fatty acids, shown to be present in many raw and drinking waters, was examined in aqueous solution at low substrate concentration (micrograms/L range). Saturated fatty acids were unreactive, unsaturated fatty acids were readily consumed. A number of reaction products of their methylated derivatives were identified by gas chromatography and gas chromatography-mass spectrometry. The products identified are consistent with a 1,3-dipolar cyclo-addition reaction. Theoretical considerations suggest that the role of radicals in the reactions occurring is minor. Low molecular weight polar products anticipated from the reaction of 9,12-octadecadienoic acid were not observed. Employment of additional extraction, derivatization and/or GC techniques will be necessary to identify these short chain polar compounds. (Author's abstract)
W89-11691

DETERMINATION OF CARBONYL COMPOUNDS IN OZONATED WATER BY THE PFBOA METHOD,
Kyoto Univ. (Japan). Faculty of Engineering.
For primary bibliographic entry see Field 5A.
W89-11692

LONG-RANGE FINANCIAL PLANNING FOR WATER UTILITIES.
Tucson Water Dept., AZ.
R. L. Brice, and E. R. Unangst.
Journal of the American Water Works Association JAWWA5, Vol 81, No. 5, p 48-52, May 1989. 5 tab.

Descriptors: *Long-term planning, *Utility extension, *Economic aspects, *Financing, *Management planning, *Metropolitan water management, Utilities, Economic aspects, Tucson, Arizona, Public participation, Forecasting, Capital markets, Inflation, Policy making.

Water utilities across the United States, especially those serving rapidly growing areas, have become aware of the need for long-range financial planning to respond to changes in the nation's economy, to evaluate and plan for the impact of the 1986 Safe Drinking Water Act amendments on their operation and capital program, to accommodate changes in national tax legislation affecting investment and bond markets, and to evaluate changing patterns of water use brought about by conservation efforts. The process employed by the Tucson (Arizona) Water Department to develop long-range financial plans is discussed. Fundamental steps in this process include establishment of a mechanism for citizen involvement, formulation of policies that guide financial planning efforts, and identification of the components of a financial plan and of the tools used in the planning process. Data are presented covering various financial aspects of Tucson Water for the period 1988-1997, including: capital improvement plan, projected financing of capital improvements, projected operation and maintenance expenses with inflation factor, projection of water services and sales, and projected operating results with present rates and with inflation factor. The preparation and publication of long-range financial plans have built confidence and credibility in Tucson Water among both customers and policy-makers. (Author's abstract)
W89-11736

LONG-TERM CONTRACTS FOR LARGE USERS: AN INDUSTRY VIEWPOINT.
General Motors Corp., Detroit, MI.
R. A. Smith.
Journal of the American Water Works Association JAWWA5, Vol 81, No. 5, p 53-56, May 1989.

Descriptors: *User charges, *Metropolitan water management, *Contracts, *Water rates, *Industrial water, General Motors Corporation, Management planning, Negotiations, Communication, Costs, Economic aspects, Water supply.

General Motors Corp. (GM) negotiates rates and service contracts with its water suppliers as often as possible, based on fairness to the water utility, the utility's other customers, and GM. Water rates, in GM's view should be adequate to maintain the operational and financial stability of the utility as a self-supporting enterprise and should be based on the cost of service, without cross-class customer subsidization or revenue subsidies. Detailed rate and service contracts are used by GM as vehicles to achieve these goals with its water suppliers. Many provisions can be included in a contract. First, contracts must be tailored to the particular situation, the supplier, and the user. Several guidelines have been developed by GM to assist in its discussions and negotiations with suppliers. These criteria include a detailed checklist of many of the contract and rate provisions that may be shared by many utilities, a prototype water contract, data required to make a complete cost-of-service analysis, criteria and various guidelines for conducting associated cost studies, and criteria for retaining qualified consultants to perform such work. GM believes that it has been reasonably successful in implementing this approach. The process is time-consuming, requires a certain level of expertise and knowledge, and requires many meetings, much paper, effort, and patience. GM believes the process leads to better understanding, communication, and reflection of each other's mutual concerns. (Rochester-PTT)
W89-11737

FORECASTING DEMAND AND MEASURING PRICE ELASTICITY.
East Bay Municipal Utility District, Oakland, CA.
For primary bibliographic entry see Field 6D.
W89-11738

INFLUENCE OF BACKGROUND ORGANIC MATTER ON GAC ADSORPTION,
Karlsruhe Univ. (Germany, F.R.).
R. S. Summers, B. Haist, J. Koehler, J. Ritz, and G. Zimmer.
Journal of the American Water Works Association JAWWA5, Vol 81, No. 5, p 66-74, May 1989. 15 fig, 1 tab, 14 ref.

Descriptors: *Water treatment, *Activated carbon, *Organic matter, *Adsorption, *Chlorinated hydrocarbons, Rhine River, Trichloroethene, Trichlorobenzene, Design criteria, Performance evaluation, Biodegradation.

Background organic matter in the Rhine River significantly affected the behavior of trichloroethene (TCE) and 1,2,4-trichlorobenzene (TCB) in granular activated carbon (GAC) adsorption columns. The GAC column adsorption capacity for TCE was more than 50% less than that found in batch adsorption experiments. The capacity for TCE of GAC preloaded with organic matter was very similar to that of a TCE-spiked GAC column, suggesting that the preloading isotherm approach can be useful in predicting GAC column capacity. Because of long-term reductions in adsorption capacity, the breakthrough of TCE in a full-scale column is not well predicted by the direct scaleup approach. Complete removal of TCB, presumably by biodegradation, was found after 40 days of operation. (Author's abstract)
W89-11739

IMPACT OF INCORPORATED ORGANIC MATTER ON THE DEWATERING CHARACTERISTICS OF ALUMINUM HYDROXIDE SLUDGES,
Woolpert Consultants, Dayton, OH.
B. E. Dulin, and W. R. Knocke.
Journal of the American Water Works Association JAWWA5, Vol 81, No. 5, p 74-79, May 1989. 10 fig, 3 tab, 20 ref.

Descriptors: *Sludge drying, *Water treatment, *Alum, *Organic matter, Performance evaluation, Flocculation, Potassium permanganate, Process control, Sludge thickening, Coagulation.

The effects of coagulation of organic matter by alum, as influenced by coagulation pH, dosage, and potassium permanganate peroxidation, on the thickening and dewatering characteristics of aluminum hydroxide sludges were examined. Sludge dewatering characteristics worsened as the specific amount of organic matter incorporated into the sludge floc matrix increased. The observed changes in sludge characteristics were correlated to a decrease in sludge floc size and density that occurred when greater amounts of organic matter were incorporated into the floc structure. Addition of potassium permanganate improved sludge dewatering rates. The dosage required for improvement of sludge dewatering rates was a direct function of the amount of organic matter present in the sludge. (Author's abstract)
W89-11740

RAW WATER CHARACTERISTICS AND THE SELECTION OF TREATMENT CONFIGURATIONS FOR PARTICLE REMOVAL.
Rice Univ., Houston, TX. Dept. of Environmental Science and Engineering.
M. R. Wiesner, and P. Mazounie.
Journal of the American Water Works Association JAWWA5, Vol 81, No. 5, p 80-89, May 1989. 4 fig, 3 tab, 25 ref.

Descriptors: *Water treatment, *Raw water, Organic matter, Particulate matter, Systems analysis, Filtration, Coagulation, Performance evaluation, Chemical treatment, United States, Belgium, Paraguay, France, Switzerland, Algae, Mathematical models, Optimization, Flocculation, Design criteria, Dissolved solids, Water quality.

The particle-removal performance of several full-scale water treatment plants was evaluated using a systems analysis approach. Raw water characteristics and configurations of seven treatment plants in

Belgium, Paraguay, France, Switzerland, and the United States are described to illustrate the relationship between important raw water characteristics and the selection of unit processes for particle removal. 'Dissolved' organic materials in raw water may be an important source of particle volume when coagulation precedes liquid-solid separation. Different inorganic coagulants yielded different solid phases when added to water. After the distribution of particle sizes in raw water was adjusted for changes resulting from dissolved organic carbon in water, configurations of the unit processes chosen in practice corresponded in most cases to configurations calculated to be cost-optimal. Variations in raw water quality were not considered in the model. If significant fluctuations in turbidity, dissolved organic carbon, algal counts, or particle-volume concentration occur, it may be more appropriate to use a value greater than the mean particle-volume concentration to estimate the optimal configuration for these waters. Model calculations indicate that contact filtration should be optimal for raw waters containing 2 ppm or less of particle volume and that conventional treatment should be optimal when the particle volume concentration in the raw water is greater than 10 ppm. In the range of 2-10 ppm of particle volume, particle-size conditioning in flocculation is important. Even for cases in which contact filtration is predicted to be the optimal treatment configuration, it would seem prudent to consider flocculation as an option before filtration. This would provide greater flexibility in dealing with short-term changes in raw water characteristics or long-term degradation of the raw water quality. (Rochester-PTT)
W89-11741

OVERALL EFFECT ON ANNUAL COSTS OF A REDUCTION IN WATER USE WITH SEPARATE METERING OF FLATS IN PRETORIA.
Water Research Commission, Pretoria (South Africa).
For primary bibliographic entry see Field 3D.
W89-11747

TRITIUM AS AN INDICATOR OF RECHARGE AND DISPERSION IN A GROUNDWATER SYSTEM IN CENTRAL ONTARIO.
Waterloo Univ. (Ontario). Inst. for Ground Water Research.
W. D. Robertson, and J. A. Cherry.
Water Resources Research WRERAO, Vol. 25, No. 6, p 1097-1109, June 1989. 13 fig, 26 ref.

Descriptors: *Tracers, *Groundwater movement, *Ontario, *Radioactive tracers, *Groundwater recharge, *Dating, Tritium, Bomb tests, Isotope studies, Mathematical models, Simulation, Sand aquifers.

The detailed distribution of tritium (3H) in the recharge area of a shallow unconfined sand aquifer near Sturgeon Falls, Ontario, is described. At this forested, shallow-water table site, bomb tritium has penetrated uniformly to a depth of 8-12 m, indicating recharge of 15 cm/yr, which is 16% of precipitation. The zone of bomb tritium contains 3H concentrations of 16-269 tritium unit (TU), whereas much lower values (<1 TU) are observed in groundwaters recharged only a few years prior to 1953, the year when significant fallout from bomb tritium began. Tritium distribution is accurately simulated, using one-dimensional and two-dimensional models, when the Ottawa record is used for the post-1953 tritium input fraction, when dispersion is low, and when a pre-bomb tritium input value of 3 TU is used. This pre-bomb value is slightly below that suggested in 1954 by Kaufman and Libby based on precipitation and surface water sample taken in the early 1950s. The simulations indicate, and field data corroborate, that in 1986 3H levels of more than 100 TU occur in only in groundwaters recharged between 1957 and 1971, whereas levels exceeding 200 TU occur only in groundwaters recharged during 1961-1967. The 1960s tritium peak is observed within a narrow, distinct depth zone at all locations along the flow section investigated. (Author's abstract)
W89-11753

ATMOSPHERIC SULFUR DEPOSITION 1950-1985 INFERRED FROM SULFATE IN GROUNDWATER.
Waterloo Univ. (Ontario). Inst. for Ground Water Research.
For primary bibliographic entry see Field 5B.
W89-11754

INACTIVATION OF GIARDIA MURIS CYSTS BY CHLORAMINES.
Oregon Health Sciences Univ., Portland. Dept. of Microbiology and Immunology.
E. A. Meyer, J. Glicker, A. K. Bingham, and R. Edwards.
Water Resources Bulletin WARBAQ, Vol. 25, No. 2,p 335-340, April 1989. 1 fig, 5 tab, 14 ref.

Descriptors: *Disinfection, *Giardia, *Chloramines, *Disinfection, *Water treatment, Temperature effect, Hydrogen ion concentration, Protozoa, Ammonia, Chlorine.

In a study to measure the efficacy of chloramines at inactivating Giardia cysts, the ability of cysts to excyst was measured after exposure to different times, and at different temperatures and pH. The chloramines were generated by mixing ammonium sulfate and sodium hypochlorate in water to approximate a 7:1 chlorine:ammonia ratio by weight. Times of 40, 80, 180, and 270 minutes; temperatures of 3 C, 10 C, and 18 C; target chloramine concentrations of 0.4, 1.4, 2.0, and 2.6 mg/L; and pH of 7.0 and 8.5 were the actual values tested. The combinations of these variables that were able to inactivate > 99.8% of the cysts were a minimum chloramine concentration of 2.26 mg/L applied for 270 minutes at a water temperature of 10 C; and at 18 C, averaged minimum chloramine concentrations of 2.14 and 1.55 mg/L applied for 180 and 270 minutes, respectively. The minimum CT the product of the terminal disinfectant concentration in mg/L times the number of minutes of exposure to the disinfectant values corresponding to these combinations capable of > 99.8% cyst inactivation, are 610 at 10 C and 385 at 18 C. Temperature was noted to exert a major effect on the ability of chloramines to inactivate cysts. Modifications of the methods used to generate chloramines may have an effect on the capacity of this disinfectant to inactivate cysts. (Author's abstract)
W89-11795

MULTIDISCIPLINARY PLANNING AND MANAGING OF WATER REUSE.
King Abdulaziz Univ., Jeddah (Saudi Arabia). Dept. of Civil Engineering.
A. M. Mohorjy.
Water Resources Bulletin WARBAQ, Vol. 25, No. 2, p 433-442. April 1989. 4 fig, 10 ref.

Descriptors: *Water reuse, *Water management, *Water supply development, Management planning, Water demand, Economic aspects, Wastewater renovation.

Water reclamation and reuse are rapidly expanding areas of water supplies. A comprehensive planning methodology for developing and evaluating water reuse alternatives uses five phases: (1) goal setting, (2) identification of reuse opportunities, (3)development and evaluation of planning alternatives, (4) assessment of water reuse linkages, and (5) making decisions and recommendations. A tool called 'input-output modeling' is used in the third phase to present numerical data and choices. The methodology seeks to integrate the hydrologic and socio-economic aspects of water resources planning in the area of study. Water reuse may satisfy some of the increasing demands for water, but water quality, economics, public attitudes, and legal and institutional constraints may impose limits on the extent to which it can be employed. An analysis of proposed and existing water reuse practices worldwide indicates that reused water, if it is prepared using appropriate technology, can be as safe as, or safer than, other conventional systems for providing the water needed for municipal, agricultural, industrial, and recreational uses. As in any other system, failure is possible, and safeguards to protect the public must be built in from the start. Since technically proven processes exist to prepare water of almost any quality desired, reuse has a rightful place in planning the optimal use of water. The cost of treatment may make it difficult for small communities or small cities to reuse water. However, large communities, especially if a program is adopted nationwide, may be able to increase their water supply by 50% or more by reusing wastewater. (Lantz-PTT)
W89-11806

TOXICITY OF ALUM SLUDGE TO CERIODAPHNIA DUBIA AND PIMEPHALES.
Johns Hopkins Univ., Shady Side, MD. Aquatic Ecology Section.
For primary bibliographic entry see Field 5C.
W89-11816

1974 DRINKING WATER STANDARDS AND GUIDELINES.
Environmental Protection Agency, Washington, DC. Div. of Water Supply.
For primary bibliographic entry see Field 5G.
W89-11889

EVALUATING HOMEOWNERS' GROUND WATER TREATMENT OPTIONS.
Pennsylvania State Univ., University Park. Dept. of Agricultural Economics and Rural Sociology.
D. K. Klinko, and C. W. Abdalla.
IN: Proceedings of the FOCUS Conference on Eastern Regional Ground Water Issues, September 27-29, 1988, Stamford, Connecticut. National Water Well Association, Dublin, Ohio, 1988. p 371-382, 4 tab, 6 ref.

Descriptors: *Domestic water, *Groundwater quality, *Water quality control, *Water treatment, Costs, Wells, Economic aspects, Rural areas, Groundwater pollution, Monitoring, Cost analysis, Social aspects, Policy making.

Contamination of groundwater can create a difficult and complex problem for homeowners relying on private individual water wells. Since private water supplies are not regulated under the federal Safe Drinking Water Act, monitoring and treatment is up to the individual homeowner. If an individual discovers a water contaminant, he or she may choose one of several methods to remedy the problem, including: (1) connecting to an existing public community water system; (2) working with other affected homeowners to construct a new community system; (3) drilling a new well; or (4) using home point-of-use/point-of-entry (POU/POE) water treatment technology. This study focused on the innovative application of home or POU/POE water treatment technology. Cooperatively adopting POU/POE systems has monetary benefits associated with it in the form of quantity discounts. In addition, there is reason to believe that there are other savings through sharing the tasks involved with procuring the units. However, these savings were not quantified in this study. Cooperating also appears to add the benefit of moral support among group members, making the complex contamination problem seem more manageable. Lastly, there is evidence that various nonmonetary factors influence the feasibility of the cooperation innovation, and should be considered by community members and policy-makers contemplating treatment options. (See also W89-11916) (Lantz-PTT)
W89-11938

AERATION FOR THE REMOVAL OF RN FROM SMALL WATER SUPPLIES.
Lowry Engineering, Inc., Unity, ME.
S. B. Lowry, and J. D. Lowry.
IN: Proceedings of the FOCUS Conference on Eastern Regional Ground Water Issues, September 27-29, 1988, Stamford, Connecticut. National Water Well Association, Dublin, Ohio, 1988. p 603-612, 3 fig, 30 ref.

Descriptors: *Water supply, *Domestic water, *Municipal water, *Radon, *Water treatment,

*Aeration, *Groundwater pollution, Radioactivity, Field tests, Activated carbon.

Aeration is an emerging technology for the removal of radon from small public and private water supplies. It offers advantages over granular activated carbon (GAC) by avoiding the retention of radon progeny which causes an elevated gamma exposure rate and a potential for low level radioactive waste generation. A new diffused bubble aeration technology also offers advantages over packed tower aeration in terms of economics, performance, and aesthetics. This paper reports on recent field data from twenty prototype diffused bubble aeration systems located in six northeastern states. Theoretical and actual performance will be discussed for flows ranging from point-of-entry (POE) up to 400 gallons per minute. The technology is capable of removing > 99.9% of the raw water radon from these supplies. Removal is greater than that achieved with GAC or packed tower aeration. (See also W89-11916) (Author's abstract)
W89-11950

ENGINEERING ECONOMICS OF RURAL WATER SUPPLY AND WASTEWATER SYSTEMS. PART II: APPLICATION OF ECONOMIC CRITERIA TO THE EVALUATION OF PROJECT FEASIBILITY (A CASE STUDY).
Rice Univ., Houston, TX. Dept. of Geology.
For primary bibliographic entry see Field 5D.
W89-11967

RURAL WATER SUPPLY: HOW BAD A PROBLEM.
Environmental Protection Agency, Washington, DC.
W. J. Whitsell.
IN: Water Pollution Control in Low Density Areas: Proceedings of a Rural Environmental Engineering Conference, September 26-28, 1973, Warren, Vermont. University Press of New England, Hanover, New Hampshire, 1975. p 193-200, 32 ref.

Descriptors: *Rural areas, *Water supply, *Surveys, *Water quality, *Water quality management, State jurisdiction, Federal jurisdiction.

A survey of states conducted by the US Environmental Protection Agency (EPA) in 1971 revealed that one third of the state and local agencies responding gave their rural water supplies ratings of good or better, while two thirds rated the as less than good. Enough data have been collected by federal, state, and local agencies to establish beyond reasonable doubt that the problem is serious for many areas of the country. From these data, one can estimate that at least 40% of the individual home water supplies deliver water which does not meet the US Public Health Service 1962 Drinking Water Standards, because they contain too many coliform bacteria or too much of certain minerals or have an unpleasant taste or odor. State and local health department and other agencies having responsibilities for water supply protection react in different ways to reports of contamination. Forty percent of the states answering had not authority to impose minimum construction standards. Most of the reporting agencies stated that separate bacteriological records for individual supplies were being kept. Nevertheless, only one quarter of them knew of analyses, summaries, or interpretations of the data. One encouraging sign was that about one half of those reporting knew of plans to promote individual water supply legislation in some form. (See also W89-11953) (Lantz-PTT)
W89-11969

EROSION-TYPE HYPOCHLORINATORS FOR THE DISINFECTION OF WATER SUPPLY AND WASTEWATER IN LOW DENSITY AREAS.
Yale Univ., New Haven, CT. School of Medicine.
For primary bibliographic entry see Field 5D.
W89-11970

WATER SUPPLY AND WASTEWATER DISPOSAL: INTERNATIONAL ALMANAC, VOLUME 1.
A. Kepinski, and W. A. S. Kepinski.
Vulkan-Verlag, Essen, West Germany. 1976. 321p.

Descriptors: *Wastewater disposal, *Water supply, *Bibliographies, Information exchange, Public health, Administration, Management planning, Education, Social aspects.

This almanac is an international bibliography for the transfer, evaluation, adaptation and use of existing knowledge in the fields of water supply and wastewater disposal. It enables any specialist or researcher to find adequate references and information on all questions and aspects of the subject. Nine volumes of the almanac have been published. This, the first volume, covers general and multidisciplinary problems, such as: health, hygiene, housing, human environment, communities, authorities, public utilities, administration, management, planning, public relations, law, legislation, social factors, costs, economic factors, financing, human resources, education, training, research, investigations, methodologies, information, documentation, and international relations. This volume also has a section which lists significant periodicals in the fields of water suppply and wastewater disposal. (See W89-111983 thru 11991) (Lantz-PTT)
W89-11983

WATER SUPPLY AND WASTEWATER DISPOSAL: INTERNATIONAL ALMANAC, VOLUME 2.
A. Kepinski, and W. A. S. Kepinski.
The Hague, Zoetermeer, The Netherlands. 1977. 350p.

Descriptors: *Wastewater disposal, *Water supply, *Bibliographies, Information exchange, Water conveyance, Rural areas, Filtration.

This almanac is an international bibliography for the transfer, evaluation, adaptation and use of existing knowledge in the fields of water supply and wastewater disposal. It enables any specialist or researcher to find adequate references and information on all questions and aspects of the subject. Nine volumes of this almanac have been published. This, the second volume, covers water supply: types and characteristics of water supply systems (continued in Volume 7); geographical survey of water supply systems (continued in Volume 7); filtration of water (continued in Volume 8); rural water supply (continued in Volume 7); and water supply in developing countries (continued in Volume 7). This volume also has sections listing international organizations and handbooks, textbooks, and manuals in the field of water supply. (See W89-11983 and W89-11985 thru W89-11991) (Lantz-PTT)
W89-11984

WATER SUPPLY AND WASTEWATER DISPOSAL: INTERNATIONAL ALMANAC, VOLUME 3.
A. Kepinski, and W. A. S. Kepinski.
The Hague, Zoetermeer, The Netherlands. 1978. 322p.

Descriptors: *Wastewater disposal, *Water supply, *Bibliographies, Information exchange, Groundwater budget, Wells, Well construction, Maintenance, Groundwater pollution, Water pollution prevention.

This almanac is an international bibliography for the transfer, evaluation, adaptation and use of existing knowledge in the fields of water supply and wastewater disposal. It enables any specialist or researcher to find adequate references and information on all questions and aspects of the subject. Nine volumes of this almanac have been published. This, the third volume, discusses groundwater and wells: characteristics and types of groundwater intaking; characteristics and types of wells; well hydraulics; well design and construction; efficiency and operation of wells; ageing, corrosion, incrustation and renovation of wells; and pollution and protection of wells and groundwater. This volume also has a general section discussing the topics of groundwater conservation and utilization in Canada and of practical formulas for estimating well capacity. (See W89-11983 thru W89-11984 and W89-11986 thru W89-11991) (Lantz-PTT)
W89-11985

WATER SUPPLY AND WASTEWATER DISPOSAL: INTERNATIONAL ALMANAC, VOLUME 4.
A. Kepinski, and W. A. S. Kepinski.
The Hague, Zoetermeer, The Netherlands. 1978. 357p.

Descriptors: *Wastewater disposal, *Water supply, *Bibliographies, Information exchange, Water conveyance, Pipelines, Pipes, Hydraulic design, Corrosion, Maintenance.

This almanac is an international bibliography for the transfer, evaluation, adaptation and use of existing knowledge in the fields of water supply and wastewater disposal. It enables any specialist or researcher to find adequate references and information on all questions and aspects of the subject. Nine volumes of this almanac have been published. This, the fourth volume, surveys literature discussing pipeline information, such as: types and characteristics of pipelines; planning, designing and hydraulics of pipelines; materials and construction; operation and maintenance; ageing corrosion; damage and protection of pipelines; contamination and water quality deterioration in pipelines; planning of networks; and water meters and water metering. (See W89-11983 thru W89-11985 and W89-11987 thru W89-11991) (Lantz-PTT)
W89-11986

WATER SUPPLY AND WASTEWATER DISPOSAL: INTERNATIONAL ALMANAC, VOLUME 5.
A. Kepinski, and W. A. S. Kepinski.
The Hague, Zoetermeer, The Netherlands. 1978. 316p.

Descriptors: *Wastewater disposal, *Water supply, *Bibliographies, Information exchange, Sludge digestion, Activated sludge process, Wastewater treatment.

This almanac is an international bibliography for the transfer, evaluation, adaptation and use of existing knowledge in the fields of water supply and wastewater disposal. It enables any specialist or researcher to find adequate references and information on all questions and aspects of the subject. Nine volumes of this almanac have been published. This, the fifth volume, discusses: wastewater characteristics and treatment, and sludge processing and disposal. This volume also contains sections on relevant national associations (continued from Volume 4) and on handbooks, textbooks, and manuals in the field of wastewater disposal (continued in Volume 6). (See W89-11983 thru W89-11986 and W89-11988 thru W89-11991) (Lantz-PTT)
W89-11987

WATER SUPPLY AND WASTEWATER DISPOSAL: INTERNATIONAL ALMANAC, VOLUME 6.
A. Kepinski, and W. A. S. Kepinski.
The Hague, Zoetermeer, The Netherlands. 1984. 325p.

Descriptors: *Wastewater disposal, *Water supply, *Bibliographies, Information exchange, Waste disposal, Design standards, Waste disposal sites.

This almanac is an international bibliography for the transfer, evaluation, adaptation and use of existing knowledge in the fields of water supply and wastewater disposal. It enables any specialist or researcher to find adequate references and information on all questions and aspects of the subject. Nine volumes of this almanac have been published. This, volume 6, covers various aspects of wastewater disposal systems, such as: planning; designing; operation and geographical survey of

wastewater disposal systems; types and characteristics of wastewater collection; and sewer systems. This volume also contains a listing of handbooks, textbooks, and manuals in the field of wastewater disposal (continued in Volume 5). (See W89-11983 thru W89-11987 and W89-11989 thru W89-11991) (Lantz-PTT)
W89-11988

WATER SUPPLY AND WASTEWATER DISPOSAL: INTERNATIONAL ALMANAC, VOLUME 7.
A. Kepinski, and W. A. S. Kepinski.
The Hague, Zoetermeer, The Netherlands. 1985. 324p.

Descriptors: *Wastewater disposal, *Water supply, *Bibliographies, Information exchange, Water conveyance, Pipelines, Pipes, Rural areas, Developing countries.

This almanac is an international bibliography for the transfer, evaluation, adaptation and use of existing knowledge in the fields of water supply and wastewater disposal. It enables any specialist or researcher to find adequate references and information on all questions and aspects of the subject. Nine volumes of this almanac have been published. This, the seventh volume, discusses water supply: types and characteristics of water supply systems (continued from Volume 2); geographical survey of water supply systems (continued from Volume 2); rural water supply (continued from Volume 2); and water supply in developing countries (continued from Volume 2). This volume also contains a general section containing articles on international cooperation in the field of water supply, water-supply technical assistance needs in developing countries, and water supply and wastewater disposal in Kuwait. (See W89-11983 thru W89-11988 and W89-11990 thru W89-11991) (Lantz-PTT)
W89-11989

WATER SUPPLY AND WASTEWATER DISPOSAL: INTERNATIONAL ALMANAC, VOLUME 8.
A. Kepinski, and W. A. S. Kepinski.
The Hague, Zoetermeer, The Netherlands. 1987. 342p.

Descriptors: *Wastewater disposal, *Water supply, *Bibliographies, Information exchange, Filtration, Water treatment, Disinfection.

This almanac is an international bibliography for the transfer, evaluation, adaptation and use of existing knowledge in the fields of water supply and wastewater disposal. It enables any specialist or researcher to find adequate references and information on all questions and aspects of the subject. Nine volumes of this almanac have been published. This, the eighth volume, discusses the filtration of water (continued in Volume 2), and disinfection of water. This volume also contains a section listing water utilities (continued in Volume 9). (See W89-11983 thru W89-11989 and W89-11991) (Lantz-PTT)
W89-11990

WATER SUPPLY AND WASTEWATER DISPOSAL: INTERNATIONAL ALMANAC, VOLUME 9.
A. Kepinski, and W. A. S. Kepinski.
The Hague, Zoetermeer, The Netherlands. 1988. 296p.

Descriptors: *Wastewater disposal, *Water supply, *Bibliographies, Information exchange, Pumping, Water storage.

This almanac is an international bibliography for the transfer, evaluation, adaptation and use of existing knowledge in the fields of water supply and wastewater disposal. It enables any specialist or researcher to find adequate references and information on all questions and aspects of the subject. Nine volumes of this almanac have been published. This, the ninth volume, discusses water pumping and water storage. This volume also contains a section listing water utilities (continued from volume 8). (See W89-11983 thru W89-11990) (Lantz-PTT)
W89-11991

1989 ANNUAL BOOK OF STANDARDS. SECTION 11: WATER AND ENVIRONMENTAL TECHNOLOGY, VOLUME 11.02.
American Society for Testing and Materials, Philadelphia, PA.
For primary bibliographic entry see Field 5A.
W89-12001

LASER/MICROBE BIOASSAY SYSTEM.
Technical Assessment Systems, Inc., Washington, DC.
For primary bibliographic entry see Field 5A.
W89-12015

AUTOMATED ONDA CORRELATION MODELING COMPARED TO ACTUAL STRIPPING TOWER PERFORMANCE.
HDR Engineering, Inc., Omaha, NE.
B. R. Larsen, T. M. Sanders, and T. J. Furne.
IN: HWHM 88: Hazardous Wastes and Hazardous Materials. Proceedings of the 5th National Conference held April 19-21, 1988, Las Vegas, Nevada. 1988. p 438-444, 8 fig, 1 tab, 14 ref.

Descriptors: *Water treatment, *Water pollution treatment, *Model studies, Air stripping, Aquifers, Groundwater pollution, Automation.

Air stripping volatile organic compounds (VOCs) from contaminated groundwater is a frequently used unit operation. Although the equipment and operations are simple, the process design can be difficult. Laboratory stripping data for a single compound in clean water allows for straight-forward design and equipment engineering. Complicated hazardous waste site and aquifer cleanups present two key challenges: (1) treatment of groundwater contaminated by more than one compound; and (2) unavailability of laboratory stripping data for the compound(s). An automated numerical design method to address these challenges was developed around the Onda prediction model for stripping coefficients. The Onda stripping model is based on several empirical relationships. The design methodology incorporates the effects of water and air temperature, volatility of the contaminant, and type and size of packing on system design. The major design-basis parameters that affect stripping tower performance include liquid flow rate and temperature, air-to-water ratio, air flow, pollutant properties, air loading rate, and packing media properties. The incorporation of the Onda correlation can serve as the basis for establishing the most cost-effective design but it is not intended to replace pilot studies of the actual liquid stream. (See also W89-12002) (Lantz-PTT)
W89-12062

CATALYTIC OXIDATION AND CARBON ADSORPTION FOR VOC EMISSIONS FROM AIR STRIPPERS.
Air Force Engineering and Services Center, Tyndall AFB, FL.
For primary bibliographic entry see Field 5G.
W89-12063

EFFECT OF POTASSIUM CHLORIDE ON THE VIRUCIDAL EFFECTIVENESS OF CHLORINE DISINFECTION FOR MILITARY NEEDS.
Cincinnati Univ., OH.
G. Berg.
Available from the National Technical Information Service, Springfield, VA 22161, as AD-A198 246. Price codes: A04 in paper copy, A01 in microfiche. November 10, 1987. 89p, 17 fig, 11 tab, 11 ref, 4 append. Department of the Army Contract DAMD7-86-C-6213.

Descriptors: *Viricides, *Chlorination, *Water treatment, *Disinfection, *Potassium chloride, *Viruses, Drinking water, Potable water, Hydrogen ion concentration, Chlorine, Synergistic effects.

At 5 C, in nonbuffered purified water at pH 9.0, 1 mg/L of free chlorine (FC) inactivated 99.99% of poliovirus 1 in 110 minutes and 5 mg/L of FC inactivated 99.99% of the virus in about 27 minutes. At 5 C, 526 mg/L of KCl potentiated the inactivation by FC at pH 9.0 of poliovirus 1 in nonbuffered purified water. In nonbuffered purified water, 526 mg/L of KCl increased the poliocidal effectiveness of FC by 700%. Under the same circumstances, 1,262 mg/L increased the poliocidal effectiveness of FC by 1400%. At 5 C, poliovirus 1 was inactivated by FC at pH 9.0 more than 9 times more rapidly in nonbuffered tap water than in nonbuffered purified water suggesting that KCl with or without other ions in tap water potentiated the virucidal effectiveness of FC. Potassium chloride did not potentiate the poliocidal effectiveness of FC at pH 9.0 to nearly the degree in nonbuffered tap water than it did in nonbuffered purified water suggesting that ions present in tap water potentiated the virucidal effectiveness of FC. Potassium chloride potentiated the virucidal effectiveness of FC in 0.05 M borate buffer to a lesser degree than in nonbuffered purified water further indicating that buffer ions potentiated the virucidal effectiveness of FC and that a maximum ion effect exists. Potassium chloride, at a level 1, 262 mg/L, potentiated the virucidal effectiveness of FC at pH 4.5 in phthalate-buffered purified water, but to a lesser degree than it potentiated the virucidal effectiveness of FC at pH 9.0 in borate-buffered purified water. (Lantz-PTT)
W89-12076

DEVELOPMENT OF INNOVATIVE FLOTATION PROCESSES FOR WATER TREATMENT AND WASTEWATER RECLAMATION.
Krofta Engineering Corp., Lenox, MA.
For primary bibliographic entry see Field 5D.
W89-12095

WATER AND WASTEWATER SYSTEMS ANALYSIS.
University of the Witwatersrand, Johannesburg (South Africa). Water Systems Research Programme.
For primary bibliographic entry see Field 6A.
W89-12117

ASBESTOS IN DRINKING WATER, JANUARY 1977-MARCH 1988: CITATIONS FROM THE SELECTED WATER RESOURCES ABSTRACTS DATABASE.
National Technical Information Service, Springfield, VA.
Available from National Technical Information Service, Springfield, VA 22161 as PB88-860366, Price codes: N01 in paper copy, N01 in microfiche. March 1988. 53p. Supersedes PB87-854402.

Descriptors: *Water pollution sources, *Drinking water, *Bibliographies, *Asbestos, Plumbing, Potable water, Epidemiology, Asbestos cement, Water treatment, Public health.

This bibliography contains citations concerning the occurrence, and problems associated with asbestos fiber contaminated drinking water. The role of asbestos cement pipes and factors involved in the release of asbestos fibers are discussed. Distribution data, epidemiology studies, and health effects are considered. Detection and measurement methods are also discussed. This updated bibliography contains 137 citations of which 12 are new entries to the previous edition. (Author's abstract)
W89-12154

HEAVY METALS IN DRINKING WATER: STANDARDS, SOURCES, AND EFFECTS, JANUARY 1977-DECEMBER 1987: CITATIONS FROM THE SELECTED WATER RESOURCES ABSTRACTS DATABASE.
National Technical Information Service, Springfield, VA.
Available from National Technical Information Service, Springfield, VA 22161 as PB88-856547, Price codes: N01 in paper copy, N01 in microfiche. January 1988. 54p. Supersedes PB87-852356.

Descriptors: *Water pollution sources, *Drinking water, *Water treatment, *Bibliographies, *Heavy metals, Public health, Toxicity, Regulations, Groundwater pollution, Acid rain effects, Plumbing, Water conveyance, Water quality standards, Lead, Copper, Nickel, Mercury, Cadmium, Manganese, Zinc.

This bibliography contains citations concerning the public health aspects and documented studies of heavy metal pollutants in drinking water. Topics include human exposure studies and the toxicological effects incurred by ingestion of lead, copper, nickel, mercury, cadmium, manganese, and zinc. Prolonged exposure and quantification factors and effects, federal and state regulations and standards, and laboratory animal studies are discussed Sources from landfill contamination of groundwater, acid precipitation contributions to groundwater pollution and corrosion by products in residential plumbing and public water supply transport systems are examined. This updated bibliography contains 139 citations of which 22 are new entries to the previous edition. (Author's abstract)
W89-12161

HEAVY METALS IN DRINKING WATER: STANDARDS, SOURCES, AND EFFECTS, JANUARY 1970-JUNE 1988: CITATIONS FROM THE NTIS BIBLIOGRAPHIC DATABASE.
National Technical Information Service, Springfield, VA.
Available from National Technical Information Service, Springfield, VA 22161 as PB88-866777, Price codes: N01 in paper copy, N01 in microfiche. July 1988. 55p. Supersedes PB87-853321.

Descriptors: *Drinking water, *Water treatment, *Bibliographies, *Heavy metals, Public health, Toxicity, Regulations, Plumbing, Water conveyance, Water quality standards.

This bibliography contains citations concerning the presence of heavy metals in drinking water. The effects of plumbing systems on water quality is discussed. Standards for safe drinking water are included. Treatment techniques to remove heavy metals are described. Methods for analyzing heavy metal contaminants in water are presented. The effects of heavy metals in drinking water on human health are briefly considered. This updated bibliography contains 159 citations of which 19 are new entries to the previous edition. (Author's abstract)
W89-12163

ACTIVATED CHARCOAL FILTERS: WATER TREATMENT, POLLUTION CONTROL, AND INDUSTRIAL APPLICATIONS, JANUARY 1970-JULY 1988: CITATIONS FROM THE U.S. PATENT BIBLIOGRAPHIC DATABASE.
Ceske Vysoke Uceni Technicke v Praze. Faculty of Civil Engineering and Architecture.
Available from National Technical Information Service, Springfield, VA 22161 as PB88-867171, Price codes: N01 in paper copy, N01 in microfiche. August 1988. 55p.

Descriptors: *Water treatment, *Bibliographies, *Activated carbon, *Filtration, Drinking water, Patents.

This bibliography contains 129 citations of selected patents concerning activated charcoal filters and their applications in water treatment pollution control, and industrial processes. Filtering methods and equipment for air and water purification, industrial distillation and extraction, industrial leaching, and filtration of toxic gases and pollutants are described. Applications include drinking water purification, filtering beverages, production of polymer materials, solvent and metal recovery, swimming pool filtration, waste conversion, automobile fuel and exhaust systems and footwear deodorizing. (Author's abstract)
W89-12166

POLYELECTROLYTES: WASTEWATER AND SEWAGE TREATMENT, JANUARY 1977-JUNE 1988: CITATIONS FROM THE SELECTED WATER RESOURCES ABSTRACTS DATABASE.
National Technical Information Service, Springfield, VA.
For primary bibliographic entry see Field 5D.
W89-12167

5G. Water Quality Control

BIODEGRADATION OF CARBAMATES.
Florida Univ., Gainesville. Dept. of Soil Science.
For primary bibliographic entry see Field 5D.
W89-11081

DRINKING WATER MICROBIOLOGY RESEARCH IN THE UNITED STATES: AN OVERVIEW OF THE PAST DECADE.
Environmental Protection Agency, Cincinnati, OH. Drinking Water Research Div.
For primary bibliographic entry see Field 5F.
W89-11083

KINETICS OF METHANE-OXIDIZING BIOFILMS FOR DEGRADATION OF TOXIC ORGANICS.
Washington Univ., Seattle. Coll. of Forest Resources.
For primary bibliographic entry see Field 5B.
W89-11092

DEGRADATION OF TRICHLOROETHYLENE BY METHANOTROPHIC BACTERIA IN A LABORATORY COLUMN OF SATURATED AQUIFER MATERIAL.
Washington Univ., Seattle. Coll. of Forest Resources.
K. P. Mayer, D. Grbic-Galic, L. Semprini, and P. L. McCarty.
Water Science and Technology WSTED4, Vol. 20, No. 11/12, p 175-178, 1988. 7 ref. EPA Assistance Agreement CR-812220.

Descriptors: *Chlorinated hydrocarbons, *Water pollution treatment, *Biodegradation, *Fate of pollutants, *Biodegradation, *Methane bacteria, *Biotransformation, *Groundwater pollution, Substrates, Aquifers, Methane, Growth rates, Bacteria.

A laboratory experiment was designed to investigate the biotransformation of trichloroethylene (TCE) by bacteria using methane as a primary substrate under conditions simulating a contaminated aquifer. Solid material was acquired aseptically from an uncontaminated shallow confined aquifer and packed in glass columns. The relationship between the methane and oxygen supplied, bacterial growth, and TCE transformation was examined in an attempt to optimize a potentially applicable process of in situ treatment of groundwater. Approximately 20 percent of the 14C-labeled TCE, at an initial concentration of 50 micrograms/L, was transformed to CO2. A five-fold increase in the rate at which methane and oxygen were supplied to the columns resulted in no substantial increase in TCE tranformation. The sorption of TCE onto aquifer solids may have obscured treatment differences. Addition of hydrogen peroxide as the source of oxygen caused a decrease in methane utilization, although the impact of TCE transformation is not yet clear. (Author's abstract)
W89-11093

INSTRUMENTAL DETECTION OF COLIFORM BACTERIA FOR INDUSTRIAL CONTROL OF DRINKING WATER QUALITY.
Societe Generale pour l'Agriculture, Rueil-Malmaison (France).
For primary bibliographic entry see Field 5A.
W89-11095

EVALUATION OF MICROBIAL DETECTION METHODS AND INTERLABORATORY COMPARISONS DURING A PEROXIDE-NUTRIENT ENHANCED IN SITU BIORECLAMATION.
Du Pont de Nemours (E.I.) and Co., Wilmington, DE. Chemicals and Pigments Dept.
For primary bibliographic entry see Field 5A.
W89-11113

BIOLOGICAL ELIMINATION OF DICHLOROMETHANE FROM CONTAMINATED GROUNDWATER-INTERFERENCE BY COMPONENTS OF THE GROUNDWATER.
Stuttgart Univ. (Germany, F.R.). Inst. fuer Siedlungswasserbau, Wassergutewirtschaft und Abfalltechnik.
H. Scholz-Muramatsu, V. Schneider, S. Gaiser, and D. Bardtke.
Water Science and Technology WSTED4, Vol. 20, No. 11/12, p 393-397, 1988. 1 fig, 4 tab, 11 ref. German Fed. Ministry for Sci. and Tech. Contract No. 02 WA 86426.

Descriptors: *Chlorinated hydrocarbons, *Water pollution treatment, *Biological treatment, *Groundwater pollution, *Water pollution control, Spectrometers, Leachates, Organic compounds, Landfills, Volatility, Sensitivity analysis, Sludge.

The inhibiting factors for the biological elimination of dichloromethane (DCM) in the leachate of a lacquer sludge landfill was identified. About 50% of the inhibiting substances belong to the volatile fraction of the leachate. This fraction was analyzed by mass spectrometry. Selected compounds from this chromatogram were examined with regard to their inhibiting effect on the DCM elimination rate. A distinct inhibition was caused by 1,2-dichloroethane, ethylbenzene, and xylene. The DCM elimination was most sensitive against 1,2 dichloroethane. The compounds can be classified in the following order of decreasing interference: 1,2-dichloroethane > ethylbenzene > p-xylene > toluene > trichloroethene. Other than these compounds, the leachate contained nonvolatile inhibitors that could not be identified. (Author's abstract)
W89-11123

MARINE HYDROCARBON-DEGRADING MICROORGANISMS: COMMUNITY STRUCTURE AND BIOMASS DETERMINATION.
Oklahoma Univ., Norman. School of Civil Engineering and Environmental Science.
For primary bibliographic entry see Field 5B.
W89-11130

BACTERIAL BIODEGRADATION OF PETROLEUM HYDROCARBONS IN GROUNDWATER: IN SITU AUGMENTED BIORECLAMATION WITH ENRICHMENT ISOLATES IN CALIFORNIA.
CytoCulture International, Inc., San Francisco, CA.
R. J. von Wedel, J. F. Mosquera, C. D. Goldsmith, G. R. Hater, and A. Wong.
Water Science and Technology WSTED4, Vol. 20, No. 11/12, p 501-503, 1988. 4 fig.

Descriptors: *Water pollution treatment, *Fate of pollutants, *Microbial degradation, *Oil pollution, *Biological treatment, *Cleanup, *California, *Biodegradation, *Hydrocarbons, *Groundwater pollution, *Path of pollutants, *Aerobic bacteria, Isolation, Enrichment, Infiltration, Growth chambers, Pseudomonas, Bacteria, Petroleum products, Soil contamination.

Commercial blends of enrichment isolates of aerobic bacteria are being used for in situ biodegradation of petroleum hydrocarbons contaminating soil and groundwater at several industrial sites in California. Contaminated groundwater in aboveground chemostats are maintained with cultures of some strains of Pseudomonas bacteria. After the bioreclamation process, the water is reinfiltrated into the ground to augment the in situ biodegradation of petroleum absorbed into the soil. Preliminary results of one such bioreclamation project are reviewed to demonstrate its feasibility for aquifers contaminated with fuels, solvents, and other petroleum products. Contaminated groundwater is collected through a network of French drains and treated in a series of chemostat bioreactors designed to maximize the residence time of the exogenous bacterial cultures. Reclaimed, treated effluent water which has attained low levels of dissolved hydrocarbon is blended with additional bacterial cultures and nutrients to augment the effec-

tiveness of the process. In one petroleum products distribution site with extensive gasoline leakage in Southern California, bioreclamation resulted in benzene, toluene, xylene, and total hydrocarbon reductions of 85, 98, 33 and 93 percent, respectively. A new augmented bioreclamation project using bacteria is now underway at a former trucking terminal in Northern California. (Friedmann-PTI)
W89-11147

BIODEGRADATION AND GROWTH KINETICS OF ENRICHMENT ISOLATES ON BENZENE, TOLUENE, AND XYLENE.
Sybron Chemicals, Inc., Salem, VA.
For primary bibliographic entry see Field 5B.
W89-11148

UNIFIED THEORY FOR MICROBIAL GROWTH CONTROLLED BY MULTIPLE LIMITING SUBSTANCES,
Nanyang Technological Inst., Singapore. School of Civil and Structural Engineering.
For primary bibliographic entry see Field 5D.
W89-11150

MONITORING STRATEGIES TO DETERMINE COMPLIANCE WITH WATER QUALITY OBJECTIVES.
Inland Waters Directorate, Vancouver (British Columbia). Water Quality Branch.
For primary bibliographic entry see Field 7A.
W89-11161

ESTIMATING THE WATER QUALITY BENEFITS FROM SOIL EROSION CONTROL.
Economic Research Service, Washington, DC. Resources and Technology Div.
M. O. Ribaudo, and C. E. Young.
Water Resources Bulletin WARBAQ, Vol. 25, No. 1, p 71-78, February 1989. 1 fig, 2 tab, 19 ref.

Descriptors: *Erosion control, *Model studies, *Soil erosion, *Soil conservation, *Water quality, *Sediment transport, *Nutrient transport, Economic aspects, Recreation, Pollution load.

A framework for estimating the water quality benefits from soil erosion was developed. The framework is based on the linkages between soil erosion and offsite damages. The linkages are: erosion on the field, movement of eroded materials to waterways, impact of discharged material on water quality parameters, impact of water quality changes on the ability of water to provide economic services, and the economic value of the changes in water use. These linkages need to be modeled in order to estimate the water quality benefits from reductions in soil erosion. Methods for modeling each link on a geographic level, which enables the analyses of national soil conservation, were examined. Areas where data or models were found to be lacking include transport of sediment and nutrients to water systems, impact of discharged materials on water quality parameters, and impact of water quality on ability of water to provide economic services. An economic evaluation of 1983 soil conservation programs was presented as an example of how the framework could be used. A number of simplifying assumptions were made to represent links that could not be modeled with available data. (Author's abstract)
W89-11162

SPREADSHEET WATERSHED MODELING FOR NONPOINT-SOURCE POLLUTION MANAGEMENT IN A WISCONSIN BASIN.
Geological Survey, Madison, WI.
J. F. Walker, S. A. Pickard, and W. C. Sonzogni.
Water Resources Bulletin WARBAQ, Vol. 25, No. 1, p 139-147, February 1989. 4 fig, 5 tab, 12 ref.

Descriptors: *Nonpoint pollution sources, *Watershed management, *Water pollution control, *Computer models, Computer programs, Delavan Lake, Wisconsin, Water pollution sources, Phosphorus removal, Water quality, Model studies.

Although several sophisticated nonpoint pollution models exist, few are available that are easy to use, cover a variety of conditions, and integrate a wide range of information to allow managers and planners to assess different control strategies. A pollutant input accounting approach is presented in the form of an existing model (WATERSHED) that has been adapted to run on modern electronic spreadsheets. As an application, WATERSHED is used to assess options to improve the quality of highly eutrophic Delavan Lake in Wisconsin. WATERSHED is flexible in that several techniques, e.g. the Universal Soil Loss Equation or unit-area loadings, can be used to estimate nonpoint-source inputs. Once the model parameters are determined (and calibrated, if possible), the spreadsheet features can be used to conduct a sensitivity analysis of management options. In the case of Delavan Lake, it was concluded that, although some nonpoint controls were cost-effective, the overall reduction in phosphorus would be insufficient to measurably improve water quality. (Author's abstract)
W89-11169

MANGANESE OXIDATION RELATED TO THE RELEASES FROM RESERVOIRS.
Tennessee Technological Univ., Cookeville. Dept. of Civil Engineering.
For primary bibliographic entry see Field 5B.
W89-11175

DEGRADATION OF CHLORINATED AND NON-CHLORINATED AROMATIC SOLVENTS IN SOIL SUSPENSIONS BY PURE BACTERIAL CULTURES.
Groningen Rijksuniversiteit (Netherlands). Dept. of Biochemistry.
R. Oldenhuis, L. Kuijk, A. Lammers, D. B. Janssen, and B. Witholt.
Applied Microbiology and Biotechnology, Vol. 30, No. 2, p 211-217, February 1989. 3 fig, 1 tab, 18 ref.

Descriptors: *Water pollution treatment, *Fate of pollutants, *Biodegradation, *Aromatic compounds, *Solvents, *Soil bacteria, Chlorinated hydrocarbons, Bacteria, Benzenes, Carbon, Energy, Activated sludge, Sludge, Culturing techniques.

Several strains that utilize aromatic solvents were isolated and tested for their ability to degrade chlorinated and non-chlorinated aromatic hydrocarbons. The effect of inoculation with pure bacterial cultures on the degradation of benzene, toluene, o-xylene, m-xylene, and p-xylene, chlorobenzene, o-dichlorobenzene, and 1,3,5-trichlorobenzene in soil slurries was studied. The compounds for which organisms were added were rapidly degraded. Without inoculation, however, degradation of benzene, toluene, m-xylene and p-xylene, and chlorobenzene was slow, while o-xylene and o-dichlorobenzene were only slightly degraded. The results showed that degradation was due to growth of the inoculated cells using the aromatic compounds as sources of carbon and energy. Addition of activated sludge did not stimulate degradation. The degradation rate of aromatic solvents by the added bacteria in soil slurries was similar or higher than that observed in liquid cultures of the same organisms. (Author's abstract)
W89-11214

POLLUTION CONTROL-REGULATION AND LEGAL PROVISIONS IN INDIA.
Gujarat Narmada Valley Fertilizers Co. Ltd., Broach (India).
For primary bibliographic entry see Field 5G.
W89-11224

POLLUTION CONTROL-REGULATION AND LEGAL PROVISIONS IN INDIA.
Gujarat Narmada Valley Fertilizers Co. Ltd., Broach (India).
A. N. Aggarwal, and V. K. Karia.
Water Science and Technology WSTED4, Vol. 20, No. 10, p 57-62, 1988. 2 ref.

Descriptors: *Water pollution control, *Regulations, *India, Legal aspects, Environmental policy, Legislation, Standards, Water quality standards, Administrative agencies, Licensing, Planning, Economic aspects, Taxes, Liability.

Immediately after independence in 1946, the Government of India resorted to rapid industrialization to minimize outside dependence and to improve the standard of living. This, while helping the country to grow, also created problems of environmental management. Rapid deterioration of natural resources forced the Government to enact a number of legislative measures and create regulatory agencies both at central and state government levels. These agencies were given powers to effectively implement various Acts. Severe penalties, including fines and imprisonment, were envisaged for offenders of environmental Acts. Responsibilities were defined to avoid a scapegoat approach. On the other hand, to reward industries showing a positive approach to environmental protection, a number of fiscal incentives and tax benefits were also offered. Recently, to provide more comprehensive legislation for the protection of all the components of the environment under a single agency, a new bill entitled 'Environmental Protection Bill, 1986' has been introduced in Parliament. This regulatory approach has started to show results, and more and more industries have started to provide pollution control facilities. (Author's abstract)
W89-11224

USE OF BIOMONITORING TO CONTROL TOXICS IN THE UNITED STATES.
Environmental Research Lab.-Duluth, MN.
For primary bibliographic entry see Field 5A.
W89-11229

RECOVERY AND RECYCLING OF LIQUID EFFLUENT AT GNFC-A STEP TOWARDS ZERO EFFLUENT.
Gujarat Narmada Valley Fertilizers Co. Ltd., Broach (India).
V. K. Karia, and V. S. Joshi.
Water Science and Technology WSTED4, Vol. 20, No. 10, p 175-182, 1988. 8 tab.

Descriptors: *Process control, *Water reuse, *Industrial wastewater, *India, *Wastewater treatment, Ammonia, Ureas, Fertilizers, Vanadium, Cyanide, Oil, Irrigation, Lime, Cooling water, Slurries.

The Gujarat Narmada Valley Fertilizers Company Ltd (GNFC), a giant fertilizers and chemicals complex in India, owns the world's largest single stress ammonia and urea plants. Regarding liquid effluents, the company has successfully concluded a number of research and development projects as a result of which nearly 71% of the total volume of liquid effluent is put to productive use. This has helped the company to reduce the fresh water intake by about 18,000 cu m/day (much more than the total volume of fresh water required by the whole city). The remaining volume (29%) leaving GNFC premises completely conforms to irrigation standards and has been utilized by farmers for the last 5 years. This has resulted in a 'mini green revolution' in the water-scarce area of Bharuch District. Since the entire effluent is either being recycled within the company or being used by farmers, the company has reached a stage of zero effluent. The company also has saved more than $500,000 to date by properly managing liquid effluent. (Author's abstract)
W89-11235

MANAGING WATER QUALITY IN RELATION TO THE PETROCHEMICAL INDUSTRY.
Anglian Water Authority, Norwich (England). Norwich Sewage Div.
P. J. Matthews.
Water Science and Technology WSTED4, Vol. 20, No. 10, p 261-269, 1988. 2 tab, 33 ref.

Descriptors: *Water quality management, *Chemical industry, *Standards, *Oil pollution, Refineries, Oil wastes, Water quality, Water pollution effects, Water quality standards, Monitoring, Sampling, Wastewater analysis.

The impact of petrochemicals on the aquatic environment from the viewpoint of the water manager, is reviewed with emphasis on the effects of refinery effluents. Oil products can disrupt the ecology of environmental waters and render the management of sewerage and sewage treatment systems difficult. Water management can utilize different approaches to the avoidance of deleterious effects and that favored by the UK involves the use of quality objectives. These can be used to calculate acceptable effluent quality limits. Continued achievement of the objectives must rely on satisfactory monitoring and analytical methods. With the international nature of oil pollution, international analytical methods are being introduced. Accurate monitoring programs and clear analytical methods commonly used are essential in the understanding of environmental information but the mistake must never be made of setting standards with data derived from one method and then monitoring against that standard using a method with different performance characteristics. Oil pollution has not been in the public mind for some time in the UK, but constant vigilance by authorities for good discharge quality and avoidance of polluting entries (spillages, etc.) is vital in a world with an increasing demand for better environmental protection. (Author's abstract)
W89-11245

UNIFIED MANAGEMENT OF SURFACE AND GROUNDWATER QUALITY THROUGH CLEAN WATER ACT AUTHORITIES.
Tennessee Valley Authority, Knoxville. Environmental Quality Staff.
A. M. Duda.
Ground Water GRWAAR, Vol. 27, No. 3, p 351-362, May-June 1989. 6 fig, 1 tab, 29 ref.

Descriptors: *Water pollution control, *Water management, *Aquifer management, *Water quality control, *Water policy, *Surface-groundwater relations, *Administrative regulations, Surface water, Groundwater recharge, Storm runoff, Seasonal variation, Hydrologic properties, Geohydrology.

The case is presented for why unified management of surface water and groundwater quality is needed. The seven-state Tennessee Valley region is used as a microcosm of the nation to illustrate why the quality of surface and subsurface waters should be conjunctively managed. Subsurface and surface water are commonly linked in basins across the nation, both hydrologically and institutionally. While groundwater was thought to provide approximately 30 percent of the nation's streamflow and up to 100 percent of streamflow during low flow seasons, hydrologists now recognize that groundwater plays a more active, responsive role in the generation of storm runoff than was previously thought. Also, surface waters serve as important sources of recharge of aquifers throughout the west and for karst, wetland, and coastal hydrogeologic settings in humid areas. Unified management of subsurface and surface water quality makes both hydrologic and institutional sense for dealing with cross-media, cross-agency linkages causing water pollution. Congressional testimony presented by the Tennessee Valley Authority (TVA) suggests that this unified water quality management can be achieved through a narrow amendment to the Clean Water Act requiring state adoption of (1) surface and subsurface water classificatoin systems, (2) surface and subsurface numerical standards, and (3) conjunctive surface-subsurface water quality management programs. National minimum program requirements, federal funding, and federal program/facility compliance would provide leadership in creating new local/state/federal partnerships targeted to priority geographic areas. In this way, the state comprehensive program would become the hub around which the spokes of all different environmental and natural resource management (technology-based control) programs with surface water or groundwater quality implications would be integrated. This proactive water quality management approach would be less costly to the public than existing reactive approaches which have left taxpayers with a half million dollar remedial action bill for cleaning up our surface water resources. (Friedmann-PTT)
W89-11278

GROUNDWATER MODELING FOR SALINITY MANAGEMENT: AN AUSTRALIAN CASE STUDY.
Australian National Univ., Canberra. Centre for Resource and Environmental Studies.
For primary bibliographic entry see Field 2F.
W89-11281

IMPROVEMENTS IN THE BENTHIC FAUNA OF THE TEES ESTUARY AFTER A PERIOD OF REDUCED POLLUTION LOADINGS.
Imperial Chemical Industries Ltd., Brixham (England). Brixham Lab.
N. Shillabeer, and J. F. Tapp.
Marine Pollution Bulletin MPNBAZ, Vol. 20, No. 3, p 119-123, March 1989. 6 fig, 2 tab, 11 ref.

Descriptors: *Benthic fauna, *Water quality control, *Estuaries, *Pollution load, Species diversity, Water pollution effects, Regeneration, Ecotypes, Industrial wastes, Domestic wastes, Estuarine environment, Marine environment, Data interpretation.

The Tees Estuary (north east England) has been industrialized since the nineteenth century and used for the disposal of industrial and domestic waste. Its physical nature has been changed by canalization and dredging. In 1970, a number of water quality objectives were established by the Northumbrian River Board and local industry, and during the 1970s water quality improved. Classification analysis identifies three faunal associations within the estuary. The seaward end of the estuary has a typical estuarine fauna, and the middle reaches are dominated by an abundant fauna tolerant of organic pollution. Species diversity and abundance increased between 1979 and 1985 with a penetration of marine fauna into the estuary and increase in abundance in the middle reaches. The estuarine environment is far more dynamic than the fully marine environment and therefore there may be a wider range of temporal variation in the diversity of the benthos of an estuary. During the 1979-85 period, there was a general trend of improvement in the estuary, with a slight decline in the number of species between 1982 and 1984. This highlights the problems of interpreting data that demonstrates short-term changes and long-term trends. (Miller-PTT)
W89-11384

NON-LINEAR RESPONSE OF WET DEPOSITION TO EMISSIONS REDUCTION: A MODEL STUDY.
Ontario Ministry of the Environment, Rexdale.
P. K. Misra, R. Bloxam, C. Fung, and S. Wong.
Atmospheric Environment ATENBP, Vol. 23, No. 3, p 671-687, March 1989. 20 fig, 7 ref.

Descriptors: *Air pollution effects, *Pollution control, *Water pollution control, *Air pollution control, *Model studies, *Sulfates, *Acid rain, Oxidation, Emissions, Eulerian models, Lagrangian models.

An Eulerian atmospheric model with complex chemistry (Acidic Deposition and Oxidant Model) and a Lagrangian model with linear chemistry (Ontario Ministry of the Environment Trajectory Model) were used to simulate the wet SO4(2-) deposition pattern over eastern North America for 16 days during April 1981. The two model results agree reasonably well with each other when the 16 day average values are compared. They also show reasonable agreement with observed data. Having established the ability of the models to predict deposition patterns for 1981 emissions, reduction scenarios with 50% SO sub x and 50% SO sub x and NO sub x of the 1981 emissions were studied through the Eulerian model. Near the heavy emissions area, the reduction in SO4(2-) wet deposition is only about 30-40%. In this respect the linear Lagrangian model departs significantly from the Eulerian model. This non-linearity in response is attributed to the role of oxidants in controlling the conversion of SO2 to SO4(2-). (Author's abstract)
W89-11452

MANAGEMENT FUNCTIONS FOR EFFECTIVE CONTROLS OF GROUNDWATER CONTAMINATION.
Wisconsin Univ.-Milwaukee. Dept. of Civil Engineering.
J. Y. C. Huang.
Available from National Technical Information Service, Springfield, VA 22161 as PB89-183024/AS, price codes: A03 in paper copy, A01 in microfiche. Wisconsin Water Resources Center, Madison, Technical Report WIS WRC 88-02, 1988. 28p, 6 tab, 20 ref, append. USGS Contract 14-08-0001-G1261. USGS Project G1261-08.

Descriptors: *Groundwater management, *Groundwater pollution, *Institutional constraints, *Management planning, *Wisconsin, Groundwater, Legal aspects, Planning, Water pollution control, Public opinion, Attitudes.

Preventing groundwater pollution is the most desirable means of insuring groundwater quality. The institutional framework of groundwater protection at the state and local levels of government was evaluated. Six southeastern Wisconsin counties were investigated through personal interviews with county health officials using a questionnaire designed to identify management practices, tools, and problems as well as local sources of groundwater pollution. Based on a nationwide assessment and responses to the county questionnaire, recommendations were made on an effective means of controlling groundwater contamination. The most difficult management problem was identified as political, indicative of the lack of local level government support of groundwater protection. Because government is responsive to public opinion, the lack of support is the result of a lack of public awareness. Thus, education should be an integral part of groundwater programs in order to gain support for protection efforts. (USGS)
W89-11489

LAKE RESTORATION BY REDUCING EXTERNAL PHOSPHORUS LOADING: THE INFLUENCE OF SEDIMENT PHOSPHORUS RELEASE.
North East River Purification Board, Stirling (Scotland).
M. W. Marsden.
Freshwater Biology FWBLAB, Vol. 21, No. 2, p 139-162, April 1989. 7 fig, 1 tab, 183 ref, append.

Descriptors: *Lake restoration, *Pollution load, *Cycling nutrients, *Water pollution control, *Eutrophic lakes, *Phosphorus, *Lake sediments, *Path of pollutants, *Sediment-water interfaces, Lake morphometry, Lakes, Biomass, Eutrophication, Phytoplankton, Trophic level, Limiting nutrients.

The factors that determine the recovery of eutrophic lakes following a reduction in the external phosphorus loading are reviewed. The mean phosphorus content of a lake should decrease roughly in proportion to the reduction in phosphorus input. Where the lake phosphorus concentration does not decrease as predicted, then the release of phosphorus from the sediment is implicated. The current understanding of the processes by which sediment phosphorus is mobilized and transported into the photic zone is reviewed. The extent to which phosphorus release can maintain lake phosphorus concentrations following the reduction in external loading is influenced by lake morphometry, flushing rate, sediment type, trophic state, and history of enrichment. A reduction in the phytoplankton biomass of a lake is dependent upon the size of the decrease in lake phosphorus concentration and the degree to which phosphorus limits primary production. The importance of phosphorus in limiting phytoplankton production tends to decrease with increasing lake trophic status. Improvements in the condition of highly eutrophic lakes require very large reductions in external phosphorus loading, whereas in mildly enriched lakes, moderate changes in the supply of phosphorus have noticeable effects on phytoplankton biomass. (Author's abstract)
W89-11543

BIODEGRADATION OF TRANS-1,2-DICHLOROETHYLENE BY METHANE-UTILIZING BACTERIA IN AN AQUIFER SIMULATOR.
C.A.A. Bioremediation Systems, Boston, MA.
A. T. Moore, A. Vira, and S. Fogel.
Environmental Science and Technology ESTHAG, Vol. 23, No. 4, p 403-406, April 1989. 4 fig, 10 ref. U.S. Environmental Protection Agency Office of Exploratory Research Phase II Small Business Innovation Research Grant 68-02-4147.

Descriptors: *Water pollution treatment, *Biodegradation, *Groundwater pollution, *Simulation, *Water pollution control, *Methane bacteria, *Chlorinated hydrocarbons, Oxidation, Aliphatic hydrocarbons, Saturated soils, Sand, Mineral water, Nutrients, Oxygen, Methane, Carbon dioxide.

Methane-utilizing bacteria are known to oxidize chlorinated aliphatics such as trichloroethylene and trans-1,2-dichloroethylene (t-1,2-DCE) in aqueous solution. It has been suggested that this process could be utilized to biodegrade these compounds in contaminated groundwaters. Therefore, biodegradation of t-1,2-DCE was followed in a saturated soil reactor constructed to simulate groundwater conditions. t-1,2-DCE-contaminated water was recirculated horizontally through sand at a Darcy velocity of one foot per day. Methane-utilizing bacteria were added and stimulated by amending the recirculating water with mineral nutrients, oxygen, and methane. After these additions the concentration of t-1,2-DCE decreased and its unstable biodegradation intermediate, dichloroethylene oxide, appeared transiently. This degradation occurred during rapid utilization of methane and oxygen as well as production of carbon dioxide. Subsequent additions of t-1,2-DCE produced similar results. (Author's abstract)
W89-11593

STUDY ON WATER QUALITY CHARACTERISTICS AND WATER QUALITY MODEL IN SUYEONG ESTUARY,
National Fisheries Univ. of Pusan (Republic of Korea). Dept. of Environmental Science and Engineering.
B. H. Lee.
Bulletin of National Fisheries University of Pusan, Vol. 28, No. 2, p 23-38, December 1989. 8 fig, 10 tab, 16 ref, append. English summary.

Descriptors: *Water quality, *Model studies, *Water pollution control, *Estuaries, *Korea, Biochemical oxygen demand, Suspended solids, Ammonia, Nitrogen, Oxygen demand, Dispersion coefficient, Model studies, Water quality management, Wastewater treatment.

A study was conducted to evaluate the water quality characteristics and important factors in the water quality management of Suyeoug Estuary, Korea. The loading of biochemical oxygen demand, total suspended solids, and NH(4)-N discharged into Suyeong Bay were 40 ton/d, 29 ton/d, and 14 ton/d, respectively. The longitudinal dispersion coefficient was 270 sq m/sec (152-360 sq m/sec). The sediments were severely polluted and the oxygen consumption rate was as high as 14 g O2/sq m/d. According to the Water Quality Model, wastewater treatment and the dispersion coefficient were important factors to water quality characteristics in Suyeong Estuary. (Author's abstract)
W89-11607

RELATIONSHIP BETWEEN SUBSURFACE BIODEGRADATION RATES AND MICROBIAL DENSITY.
Virginia Polytechnic Inst., Blacksburg. Dept. of Civil Engineering.
For primary bibliographic entry see Field 5B.
W89-11617

AIR STRIPPING REMOVES PETROLEUM FROM GROUNDWATER.
Agway, Inc., Syracuse, NY.
W. McFarland.
Water Engineering and Management WENMD2, Vol. 136, No. 5, p 48-52, May 1989.

Descriptors: *Decontamination, *Water pollution treatment, *Air stripping, *Oil pollution, *Groundwater pollution, Volatile organics, Benzene, Toluene, Case studies, Wash water, Storm water.

Air stripping has proven to be one of the most practical alternatives for removing petroleum contamination from groundwater. By pumping petroleum contaminated groundwater through an air stripping tower, most volatile organic compounds (VOCs) can be removed, including nearly all benzene, toluene and xylene. Air stripping has been successfully used to remove many other volatile organic compounds as well, including chloroform, trichloroethylene, methylene chloride and carbon tetrachloride, which are contained in solvents, degreasers and other chemicals. An air stripper was used to treat a piping leak at a retail gasoline station that released approximately 110 gal of unleaded gasoline to groundwater. Over 99.9% of the volatile components from the groundwater were removed in each pass resulting in a total reduction to less than 40 ppb in an 8-month period. In a second case groundwater contamination was discovered under a large petroleum terminal by monitoring wells. Using air stripping the effluent quality was reduced to less than 30 ppb total BTX (benzene, toluene, and xylene). It was also demonstrated that air stripping can be an effective removal technique for cleanup of wash water and contaminated stormwater,as well as contaminated groundwater. (White-Reimer-PTT)
W89-11633

UPTAKE OF MERCURY FROM AQUEOUS SOLUTION BY DUCKWEED: THE EFFECTS OF PH, COPPER AND HUMIC ACID.
Louisiana State Univ. System, Baton Rouge.
For primary bibliographic entry see Field 5D.
W89-11640

PROPOSALS FOR INHIBITING ABUNDANT PHYTOPLANKTON GROWTH AT THE HEAD OF A RIVER RESERVOIR.
Ehime Univ., Matsuyama (Japan). Dept. of Environment Conservation.
H. Kagawa.
Regulated Rivers Research and Management RRRMEP, Vol. 3, No. 1-4, p 123-132, Jan-Apr 1989. 7 fig, 25 ref.

Descriptors: *Plant growth, *Phytoplankton, *Algal control, *Reservoirs, Chlorophyll a, Nutrients, Calcium, Magnesium, Trophic index, Japan, Water temperature, Lake morphology, Reservoir design.

Sites of abundant phytoplankton growth were investigated in connection with the water movement in the Ishitegawa Dam Reservoir in Japan from January 1982 to January 1984 by comparing the distributions of chlorophyll a, water temperature, and coliform bacteria. Three types of phytoplankton growth were identified with abundant surface growth at the head of the reservoir observed most frequently. This growth was believed to be caused by the mixing of the surface lake water with the inflowing nutrient-rich river water at the shallow lake-head. In addition, the effects of dissolved calcium and magnesium on the chlorophyll a and phytoplanktonic particulate phosphorus concentrations at the head of the reservoir were investigated until December 1987. A trophic index (the Ca-Mg index) was derived which correlated positively with the chlorophyll a and phytoplanktonic particulate phosphorus concentrations on a logarithmic scale and varied in relation to the changes in the same index of the inflowing river water. Based on the ecological results two proposals were presented for inhibiting abundant phytoplankton growth at the head of a river reservoir: (1) Make the head deep and, in addition, create a strong near-bottom underflow of the inflowing river water; or (2) Make a bypass in order to cut off the inflow of river water in the case of a high Ca-Mg index. (Author's abstract)
W89-11702

COORDINATION OF PUBLIC AND PRIVATE ACTION: A CASE STUDY OF LAKE RESTORATION.
Florida Univ., Gainesville. Dept. of Food and Resource Economics.
C. M. Fonyo, and W. G. Boggess.
Water Resources Bulletin WARBAQ, Vol. 25, No. 2, 309-317, April 1989. 2 fig, 2 tab, 28 ref. Gas Research Institute Contract 5080-260-1303.

Descriptors: *Water hyacinth, *Methane, *Lake restoration, *Lake Apopka, *Water quality control, *Florida, Case studies, Water hyacinths, Methane, Public participation, Economic aspects, Water quality management.

The potential for joint public and private action for lake restoration is examined using Lake Apopka, Florida, as a case study. Initial calculations indicate that private incentives alone are inadequate to attract investment in a facility to grow and harvest water hyacinths for conversion to methane gas. However, the private externality of water quality improvement associated with harvesting water hyacinths provides a key linkage between the public's water quality objectives and the private gas producer's actions. In order to establiah the potential basis for negotiation, the public's willingness to pay for environmental services associated with improved water quality is estimated and compared with the estimated subsidy required to induce private action. A conceptual framework is then presented for coordinating actions between private firms and public water management agencies in order to internalize the private externality of water quality improvement while simultaneously achieving the public and private objectives. Results indicate that the subsidization of water hyacinth production and harvesting compares favorably with alternative means of enhancing the water quality of Lake Apopka. (Author's abstract)
W89-11792

EFFECTS OF HYDROGEN AND ALUMINIUM IONS ON FISH GILLS,
Lancaster Univ. (England). Dept. of Biological Sciences.
W. T. W. Potts, and P. G. McWilliams.
IN: Acid Toxicity and Aquatic Animals. Cambridge University Press, Cambridge. 1989. p 201-220, 8 fig, 6 tab, 42 ref.

Descriptors: *Hydrogen ion concentration, *Acid rain effects, *Hydrocarbons, *Gills, *Aluminum, *Fish physiology, *Water pollution effects, Sodium chloride, Bicarbonates, Calcium, Potassium, Blood, Urine.

This review discusses and, where possible, interprets a small part of the previous work on the effects of acid waters on fish, in terms of what is known of the physiology of fresh water fish. The blood plasmas of these fish contain around 150 microequivalents (uequiv) Na(+) and 130 uequiv Cl(-) in addition to lower concentrations of other ions, particularly Ca(2+), K(+) and HCO3(-). In contrast, soft fresh waters, in which acidification may be a problem, usually contain < 0.1 uequiv NaCl/L and much lower concentrations of other ions. Although fish obtain some salts from their food, most species, including all salmonids, are dependent on the active uptake of salt from the medium to balance diffusion and urinary losses. Freshwater fish produce a dilute urine and urinary losses < 10% of the total losses, most of which take place across the body wall, particularly across the gills, where the blood plasma and external medium are separated by only a thin layer of respiratory epithelium. The gills are also the main site of salt uptake, although in some marine teleosts salt transport takes place at other sites, particularly on the inside of the operculum, and the possibility of salt uptake and loss at other sites in freshwater fish should not be overlooked. (See also W89-11837) (Lantz-PTT)
W89-11849

CANADIAN CONFERENCE ON MARINE ENVIRONMENTAL QUALITY: PROCEEDINGS.
February 29-3 March, 1988, Halifax, Nova Scotia.

The International Institute for Transportation and Ocean Policy Studies, 1236 Henry St., Halifax, Nova Scotia, Canada. 1988. 320 p. Edited by Peter G. Wells, and John Gratwick.

Descriptors: *Canada, *Conferences, *Environmental quality, *Environmental policy, *Marine environment, *Environmental protection, *Management planning, Water pollution prevention, Legislation, Water pollution control, Water quality control, Canada, United Nations.

The overall theme of the conference was 'to explore the Marine Environmental Quality (MEQ) issue and work toward a framework to prevent and resolve marine environmental protection problems in Canada.' The 1985 United Nations Environment Program (UNEP) 'Montreal Guidelines' on Protection of the Marine Environment Against Pollution from Land-Based Sources served as a primary focal point for discussion of MEQ issues and elements of a national framework. There were 67 participants from senior levels of government, industry, public organizations, universities and professional organizations, from five countries (Canada, the United States, Ireland, England and Greece). Fifteen papers were given on marine environmental principles and legislation, control strategies, and the status of the MEQ issue in Canada. One paper was submitted as supportive information on the global status of the acceptance and use of the Montreal Guidelines. (See W89-11853 thru W89-11867) (Lantz-PTT)
W89-11852

UNEP GUIDELINES FOR THE PROTECTION OF THE MARINE ENVIRONMENT AGAINST POLLUTION FROM LAND-BASED SOURCES: THEIR IMPLEMENTATION IN THE MEDITERRANEAN.
United Nations Environment Programme, Athens (Greece). Co-ordinating Unit for the Mediterranean Action Plan.
L. Jeftic.
IN: Canadian Conference on Marine Environmental Quality: Proceedings, February 29-March 3, 1988, Halifax, Nova Scotia. The International Institute for Transportation and Ocean Policy Studies, 1236 Henry St., Halifax, Nova Scotia, Canada. 1988. p 9-34, 1 fig, 3 tab, 14 ref.

Descriptors: *United Nations, *Environmental policy, *Standards, *Mediterranean Sea, *Marine environment, *Water pollution prevention, *Environmental protection, Legal aspects, Water pollution control, Regulations, International agreements, Water quality standards, Mercury, Shellfish.

The only legal instrument in the United Nations Environmental Program's (UNEP) ten Regional Seas which specifically concerns land-based sources of pollution and which entered into force is the Protocol for the protection of the Mediterranean Sea against pollution from land-based sources. This Protocol, which entered into force in June, 1983, calls for all contracting parties to take all appropriate measures to prevent, abate, combat and control pollution of the Mediterranean Sea area caused by discharges from rivers, coastal establishments or outfalls, or emanating from any other land-based sources within their territories. The contracting parties undertook to eliminate pollution from land-based sources by 'black list' substances and to strictly limit pollution by 'gray list' substances. To this end, the contracting parties adopted guidelines for progressive implementation and a calendar of actions which envisage that in the period from 1986 to 1995, measures to protect the marine environment will be proposed and adopted for each item from both lists. By the end of 1987, the contracting parties adopted common Environmental Quality Criteria for bathing waters, for shellfish waters and effluent standards for mercury discharges. (See also W89-11852) (Author's abstract)
W89-11853

LONDON DUMPING CONVENTION--ITS DEVELOPMENT AND SIGNIFICANCE TO MARINE POLLUTION CONTROL,
Scientific Group on Dumping of the London Dumping Convention, Irish Science and Technology Agency, Shannon, Ireland.
For primary bibliographic entry see Field 5E.
W89-11854

CANADIAN LEGISLATION PERTAINING TO THE PREVENTION AND CONTROL OF MARINE POLLUTION.
Department of the Environment, Ottawa (Ontario).
For primary bibliographic entry see Field 6E.
W89-11855

SOCIAL, ECONOMIC, INSTITUTIONAL AND LEGAL CONSIDERATIONS IN THE MANAGEMENT OF LAND-BASED SOURCES OF MARINE POLLUTION.
Dalhousie Univ., Halifax (Nova Scotia). Marine Affairs Program.
R. Cote, D. VanderZwaag, and I. Townsend Gault.
IN: Canadian Conference on Marine Environmental Quality: Proceedings, February 29-March 3, 1988, Halifax, Nova Scotia. The International Institute for Transportation and Ocean Policy Studies, 1236 Henry St., Halifax, Nova Scotia, Canada. 1988. p 59-74, 4 tab, 18 ref.

Descriptors: *Economic aspects, *Social aspects, *Waste management, *Wastewater management, *Water pollution sources, *Water pollution control, *Marine environment, *Legal aspects, *Water quality management, Coastal waters, Costs, Institutions, Public participation, Interagency cooperation.

Scientific and technical factors are often perceived as the major impediments to effective management of pollutant sources. It can be argued that, in the Canadian context, social, economic, institutional and legal considerations must receive a greater emphasis if governments expect to make significant gains in the protection of coastal waters. The awareness of the public must be raised while involving them in the decision-making processes. Interdisciplinary educational and research programs should also be enhanced by establishing programs similar to the Sea Grant system in the United States. From an economic perspective, management must begin to understand and quantify the true costs of current disposal practices as well as providing appropriate incentives for reducing waste discharges. Legislation must be actively utilized, through formal plans and agreements, to foster the collaboration among agencies and between levels of government. This paper explores a variety of issues associated with new institutional mechanisms and agencies which will have to be established such as intergovernmental management bodies now in place, for example, in the Fraser River Estuary, Puget Sound and Chesapeake Bay. (See also W89-11852) (Author's abstract)
W89-11856

CONTROL OF LAND-BASED POLLUTANTS FROM THE EXPERIENCES OF THE PARIS COMMISSION.
Secretary of the Oslo and Paris Commissions, New Court, 48 Carey St., London, United Kingdom.
P. Hayward.
IN: Canadian Conference on Marine Environmental Quality: Proceedings, February 29-March 3, 1988, Halifax, Nova Scotia. The International Institute for Transportation and Ocean Policy Studies, 1236 Henry St., Halifax, Nova Scotia, Canada. 1988. p 139-147, 15 ref.

Descriptors: *International commissions, *Environmental policy, *Water pollution control, *Paris Commission, Monitoring, Radioactive wastes, Environmental protection, Research priorities, Legislation.

This paper outlines the experience of the Paris Commission in the control of land-based pollutants, and describes the chief principles of the 1974 Paris Convention, including the composition of the Annexes and their functions. The measures taken to reduce radioactive discharges are recorded, and the dynamics of the Convention and the different approaches to pollution control (uniform emission standards and defining environmental quality objectives) exercised by European states, are described. The measures taken on monitoring and research are briefly discussed, and the paper concludes with a short assessment of the effectiveness of the role of the Paris Commission. (See also W89-11852) (Author's abstract)
W89-11858

STRATEGIES FOR THE CONTROL OF LAND-BASED SOURCES OF MARINE POLLUTION IN THE UNITED STATES.
Office of Technology Assessment, Washington, DC.
H. Levenson.
IN: Canadian Conference on Marine Environmental Quality: Proceedings, February 29-March 3, 1988, Halifax, Nova Scotia. The International Institute for Transportation and Ocean Policy Studies, 1236 Henry St., Halifax, Nova Scotia, Canada. 1988. p 149-154, 3 ref.

Descriptors: *Water pollution control, *Environmental policy, *Water quality control, *Water pollution sources, *Water quality management, *Marine environment, Coastal waters, Estuaries, Wastewater disposal, Regulations, Waste disposal, Management planning, Legislation, Public opinion, Administrative agencies.

Several incidents in 1987 focused public and government attention on the quality of estuaries and coastal waters in the United States--a wandering barge of municipal solid waste; the deaths of hundreds of dolphins along the east coast; and the washing ashore in New Jersey of illegally dumped hospital wastes. Prior to these incidents, the Office of Technology Assessment (OTA) concluded that many U.S. estuaries and coastal waters will continue to degrade or begin to do so during the next few decades unless additional protective measures are taken. Pipeline discharges and runoff were considered at least as important as dumping in causing damage. Even total compliance with existing regulations--an unlikely prospect--was considered insufficient to maintain or improve the health of all estuaries and coastal waters. This paper discusses: OTA's findings about the current regulatory system's ability to protect estuaries and coastal waters; marine waste disposal within the context of comprehensive waste management; OTA's analysis of policy options; and recent steps taken by the U.S. federal government to address marine pollution issues. Major remaining questions include whether or not all 'needy' waterbodies will receive adequate management, and whether or not existing and planned institutional mechanisms at all governmental levels will be used effectively to provide such management. (See also W89-11852) (Author's abstract)
W89-11859

BOSTON HARBOUR: PAST PROBLEMS AND FUTURE SOLUTIONS.
Environmental Protection Agency, Boston, MA. Region I.
For primary bibliographic entry see Field 5E.
W89-11860

MARINE ENVIRONMENTAL QUALITY MANAGEMENT IN BRITISH COLUMBIA.
Ministry of Environment and Parks, Victoria (British Columbia). PLanning and Assessment Branch.
B. Morgan, J. O'Riordan, R. W. Langford, and L. Harding.
IN: Canadian Conference on Marine Environmental Quality: Proceedings, February 29-March 3, 1988, Halifax, Nova Scotia. The International Institute for Transportation and Ocean Policy Studies, 1236 Henry St., Halifax, Nova Scotia, Canada. 1988. p 173-183, 2 fig, 11 ref.

Descriptors: *Environmental quality, *Environmental policy, *Canada, *Water quality management, *British Columbia, *Water pollution prevention, *Marine environment, Environmental protection, Water quality control, Federal jurisdiction,

Interagency cooperation, Information systems, Research priorities, Monitoring.

Protection of marine environmental quality in British Columbia is a shared responsibility of all levels of government, with support from the private sector and the public. Government agencies are pursuing their responsibilities through a variety of individual and cooperative management activities. A description of some of these current activities and some insights into the next generation of improvements and innovations are presented. The intertwined nature of federal and provincial responsibilities is identified as the primary impetus for a range of intergovernmental activities designed to protect marine environmental quality. Current strategies that relate to the United Nations Environment Program Guidelines in the areas of coastal planning, coastal environmental impact review, and marine water quality management are used to illustrate both the technical approaches being applied and the administrative mechanisms used to implement them. Some suggestions regarding improvements in the current approach to the management of marine environmental quality in British Columbia in the areas of information systems, research, monitoring and evaluation, and institutional coordination conclude the paper. (See also W89-11852) (Author's abstract)
W89-11861

PUGET SOUND: THE CHALLENGE OF IMPLEMENTING AN ESTUARY PROTECTION PLAN.
Puget Sound Water Quality Authority, Seattle, WA.
K. Fletcher.
IN: Canadian Conference on Marine Environmental Quality: Proceedings, February 29-March 3, 1988, Halifax, Nova Scotia. The International Institute for Transportation and Ocean Policy Studies, 1236 Henry St., Halifax, Nova Scotia, Canada. 1988. p 185-196, 1 fig, 2 tab, 3 ref.

Descriptors: *Puget Sound, *Estuaries, *Water pollution prevention, *Water quality management, *Management planning, *Environmental protection, International waters, Canada, Interagency cooperation, Washington, Regulations, Sediment contamination, Water pollution effects, State jurisdiction, Federal jurisdiction, Marine environment.

The state of Washington, in 1985, created a commission to prepare, adopt and oversee the implementation of a plan to protect Puget Sound--one of the most productive and beautiful estuaries in North America. Problems identified and addressed by the Puget Sound Water Quality Authority include: the accumulation of persistent toxicants in bottom sediments; increasing impacts from bacterial pollution from human and animal origin; severely diminished wildlife and fisheries habitat; rapid population growth; inadequately funded regulatory programs; fragmentation of responsibility among numerous jurisdictions and agencies; and the need to educate and involve the public in water quality decisions and actions. A comprehensive plan was adopted in 1986; one of its principal tenets is the need to anticipate and prevent problems rather than waiting to respond to damage after it has occurred. The plan's implementation is now in its second year. Challenges include: building and maintaining a partnership of local, state, tribal and federal efforts; obtaining adequate long-term funding for management programs; creating a water quality 'ethic' among the public and decision makers; undertaking sufficient monitoring and research to assure early identification of emerging problems; and addressing an 'unfinished agenda' of issues related to Puget Sound. Cooperation and communication between Canada and the United States is also a part of assuring the protection of Puget Sound, and the international Straits of Georgia and Juan de Fuca, Puget Sound's connections to the Pacific Ocean and to Canada. (See also W89-11852) (Author's abstract)
W89-11862

MARINE ENVIRONMENTAL QUALITY IN CANADA: STATUS AND ISSUES, THE PACIFIC COAST OF CANADA.
Ministry of Environment and Parks, Victoria (British Columbia). PLanning and Assessment Branch.
R. W. Langford, S. Reid, and L. Harding.
IN: Canadian Conference on Marine Environmental Quality: Proceedings, February 29-March 3, 1988, Halifax, Nova Scotia. The International Institute for Transportation and Ocean Policy Studies, 1236 Henry St., Halifax, Nova Scotia, Canada. 1988. p 209-228, 3 fig, 5 tab, 30 ref.

Descriptors: *Aquaculture, *Oil industry, *Environmental quality, *Pacific Ocean, *Coastal waters, *Environmental policy, *Marine environment, *Canada, *Water quality management, *Management planning, Industrial wastewater, Water pollution prevention, Mine wastes, Industrial wastes, Municipal wastes, Oil spills, Tourism, Boating, Ocean dumping.

Development projects, marine environmental quality issues and strategies for management are discussed in the context of the west coast of Canada. Inter-relationships of these are presented for the mariculture industry and for the offshore hydrocarbon exploration project. The mariculture industry exhibits a high public profile, high economic expectations, rapid growth, and multiple marine environmental quality concerns. These are discussed as resource use, water quality, habitat protection, health, information management, and public administration. The ability of existing management strategies to cope with this sudden birth of a new marine industry was severely tested with new needs identified and put into practice. Changes in existing strategies and evolution of new strategies are discussed. The expectation of renewed offshore oil exploration in the Queen Charlotte Sound, Dixon Entrance and Hecate Strait area has led to an active process of environmental assessment, panel review and issue analysis by resource management agencies. The inter-relationship between the issues generated by this project and the strategies for managing these issues is presented. The management of issues within these two industries is compared to the same issues which arise out of other west coast projects including mines, industrial and municipal effluents, emergency spills, tourism and boating and ocean dumping. Success of current strategies is examined and suggestions are given for improving the responsiveness and effectiveness of these and other strategies. (See also W89-11852) (Author's abstract)
W89-11864

GREAT LAKES WATER QUALITY AGREEMENT: A MANAGEMENT FRAMEWORK FOR MULTI-JURISDICTIONAL ACTION.
Environment Canada, Toronto (Ontario). Great Lakes Environment Office.
R. Shimizu.
IN: Canadian Conference on Marine Environmental Quality: Proceedings, February 29-March 3, 1988, Halifax, Nova Scotia. The International Institute for Transportation and Ocean Policy Studies, 1236 Henry St., Halifax, Nova Scotia, Canada. 1988. p 243-250, 2 fig.

Descriptors: *International agreements, *Jurisdiction, *Interagency cooperation, *Great Lakes, *Water quality management, *Water quality, Legislation, Water pollution prevention, Lake Erie, Canada, Environmental protection, Human population, Ecosystems.

The Great Lakes Basin is home to over 7 million Canadians and 29 million Americans. No one governmental authority manages its water quality and no less than 2 federal governments, 8 state governments, and 1 provincial government and scores of governmental agencies regulate some human activity which has some direct link to its water quality. When pollution became a popular public issue, the state of the Great Lakes water quality was one of the yardsticks used by the public not only in the region, but nationally in both countries. The death of Lake Erie was heralded throughout the land as a precursor to a horribly degraded world. Governmental response to the pollution of the Great Lakes is a fine example of sustained political cooperation among institutions to preserve a precious and magnificent natural resource. This paper has three purposes: (1) to describe a working multi-jurisdictional arrangement dedicated to the protection and enhancement of a large shared aquatic ecosystem; (2) to identify and discuss the critical factors which allow it to work; and (3) to discuss particular features which may be transferable to efforts to restore Marine Environmental Quality. (See also W89-11852) (Author's abstract)
W89-11866

MARINE ENVIRONMENTAL QUALITY IN CANADA: BUILDING CONSTITUENCIES.
International Inst. for Transportation and Ocean Policy Studies, Halifax (Nova Scotia).
C. Lamson, and J. Donihee.
IN: Canadian Conference on Marine Environmental Quality: Proceedings, February 29-March 3, 1988, Halifax, Nova Scotia. The International Institute for Transportation and Ocean Policy Studies, 1236 Henry St., Halifax, Nova Scotia, Canada. 1988. p 251-262, 26 ref.

Descriptors: *Environmental quality, *Social aspects, *Political aspects, *Public participation, *Marine environment, *Canada, Water quality management, Regulations, Public participation, Environmental protection, Education, Management planning, Arctic.

This paper addresses some of the key social/cultural/political factors which will influence the choice of Marine Environmental Quality (MEQ) strategy and control instruments available to Canadians. Finding mechanisms that facilitate constituency-building and promote the development of genuine management partnerships between resource users/stakeholders and professional environmental managers are among the challenges facing agencies with mandates to promote and protect MEQ. Other key issues include public awareness/education and participation in integrated resource planning and management. The Arctic is given special emphasis because the collective experience of native people, gained in land claims negotiations, may be useful in the design of other regional MEQ frameworks. (See also W89-11852) (Author's abstract)
W89-11867

AGRICULTURAL CHEMICALS IN GROUND WATER: PROPOSED PESTICIDE STRATEGY.
Environmental Protection Agency, Washington, DC. Office of Pesticides and Toxic Substances.
December 1987. 150p, 32 fig, 11 tab.

Descriptors: *Environmental policy, *Water pollution prevention, *Water quality management, *Water quality control, *Agricultural chemicals, *Groundwater pollution, *Pesticides, Regulations, State jurisdiction, Federal jurisdiction, Drinking water, Management planning, Groundwater management, Water use, Water quality standards, Interagency cooperation, Enforcement.

This document presents the US Environmental Protection Agency's (EPA) proposed strategic plan for protecting groundwater from contamination by pesticides. It is divided into three parts: a brief summary assessment of the problem; the proposed Agency strategy; and, an outline of implementation issues and questions. The potential vulnerability of groundwater to pesticide contamination is determined by a complex set of factors which vary significantly from area to area. Furthermore, the use and value of groundwaters vary considerably across the country. In some areas, groundwater provides an irreplaceable source of drinking water for large populations, while in other areas, groundwater is essentially unusable. These highly variable characteristics of the groundwater resource and the area-specific nature of the pesticide contamination concern suggest the need for a localized protection approach. The purpose of the strategy is to articulate EPA's long-term approach for managing the pesticides in groundwater. The proposed strategy is organized into three chapters that address the key issues associated with: the Agency's environmental goal; its prevention strategy; and its response strategy. EPA's environmental goal will be to manage the use of pesticides to protect the groundwater re-

source. Specific attention will be given to preventing unacceptable contamination of current and potential drinking water supplies. The Agency will use Maximum Contaminant Levels (MCLs) or other EPA-designated protection criteria as reference points for helping to determine unacceptable contamination of groundwater. The Agency's proposed strategy to prevent unacceptable pesticide contamination of groundwater will be based on a multipronged management approach with varied Federal-State roles. The Agency's policy for responding to pesticide contamination of groundwater emphasizes Federal-State coordination and statutory enforcement activities. (See also W89-11882) (Lantz-PTT)
W89-11881

AGRICULTURAL CHEMICALS IN GROUND WATER: SUMMARY MINUTES FROM THE 1987 PESTICIDE STRATEGY WORKSHOP.
Environmental Protection Agency, Washington, DC. Office of Pesticides and Toxic Substances.
October 1987. 57p, append.

Descriptors: *Environmental policy, *Water pollution prevention, *Conferences, *Groundwater pollution, *Agricultural chemicals, *Pesticides, *Water pollution control, Regulations, Monitoring, Water quality control, Fate of pollutants, Federal jurisdiction, State jurisdiction, Water quality standards, Public health, Environmental protection, Public policy, Governmental interrelations.

This document is a summary of the minutes from a US Environmental Protection Agency (EPA) Office of Pesticides and Toxic Substances (OPTS) 1987 workshop. Workshop participants were asked to comment on the Agency's proposed pesticide strategy and a number of associated implementation issues. Following the format of the pesticides strategy, the minutes are divided into three chapters: (1) the Agency's environmental goal; (2) the proposed prevention program; and (3) the proposed response program. A number of environmentalists and some state officials preferred a groundwater goal of non-degradation. Although these participants generally recognized that there was little likelihood of attaining such a goal, they believed it should nevertheless be the target. A number of state officials suggested a goal that would tolerate some contamination, but not to the extent that it would impair groundwater use. Under this goal, efforts would focus on preventing pesticide contamination of groundwater that is a current or potential drinking water source from reaching drinking water standards or health advisories. In general, state participants wanted EPA to define unacceptable groundwater contamination and establish minimum environmental protection requirements that all state pesticide management programs must strive to meet. At the same time, these participants wanted the states to have the flexibility to tailor the management of pesticide use to specific local conditions. Participants identified three basic purposes for monitoring in support of the proposed strategy: (1) monitoring to support registration; (2) monitoring to establish trends and identify emerging problems; and (3) site-specific monitoring to characterize a specific contamination problem. There was major disagreement on what EPA should do if there is no adequate state plan to respond to groundwater contamination at specific sites. Some wanted EPA to ban the use of pesticides at specific sites. Others though EPA should ban the use of a pesticide in an entire county or state where a pesticide is detected in groundwater at or above an Maximum Contamination Level or other unacceptable level and the state does not take adequate action to prevent further contamination from occurring. (See also W89-11881) (Lantz-PTT)
W89-11882

SOIL ABSORPTION OF SEPTIC TANK EFFLUENT: A FIELD STUDY OF SOME MAJOR SOILS IN WISCONSIN.
Wisconsin Geological and Natural History Survey, Madison.
For primary bibliographic entry see Field 5E.
W89-11884

HOMEOWNER'S GUIDE TO DOMESTIC WELLS,
Virginia Water Resources Research Center, Blacksburg.
K. P. Sevebeck, J. H. Kahn, and T. D. Sponenberg.
Virginia Water Resources Research Center, Blacksburg, Virginia. 1985. 26p, 8 fig, 1 tab.

Descriptors: *Handbooks, *Domestic water, *Groundwater quality, *Wells, Groundwater management, Drinking water, Bacteria, Water treatment, Maintenance, Virginia.

Approximately 1.5 million Virginians obtain their domestic water supplies from private wells and springs, using an average of 100 gallons daily per person. Well users often take it for granted that their wells will always produce a dependable supply of clean, safe drinking water. Some basic issues addressed in this booklet are: Where well water comes from; How wells are constructed; Whether wells need regular maintenance; Whether well water is always safe to drink; How water quality can be tested; and How can water be treated to remove bacteria or unwanted minerals. (Lantz-PTT)
W89-11888

1974 DRINKING WATER STANDARDS AND GUIDELINES.
Environmental Protection Agency, Washington, DC. Div. of Water Supply.
Draft, August 27, 1974. 283p, 21 tab, 492 ref, 2 append.

Descriptors: *Water quality standards, *Drinking water, *Water quality control, Coliforms, Bacteria, Chemical analysis, Organic compounds, Herbicides, Pesticides.

The Standards published here became effective upon appearance in the Federal Register. They are the Standards to which drinking water and water supply systems used by carriers and other subject to Federal quarantine regulations must conform. The Water Supply Division, Environmental Protection Agency (EPA), is responsible for the application of these Standards to all carrier water supplies. These Standards supersede the Public Health Service Drinking Water Standards--1962. Since the legal authority of the EPA to promulgate Drinking Water Standards is limited to such factors as relate to communicable disease, other aspects of drinking water quality, including those formerly regulated by the 1962 Standards as well as those added by the Advisory Committee, are covered in the 1974 Drinking Water Guidelines, attached to this publication. The 'Standards' address limits and values for coliforms, turbidity, and bacteria, while the 'Guidelines' address limits for all the elements and a variety of organic compounds, such as pesticides and herbicides. (Lantz-PTT)
W89-11889

VOLATILE ORGANIC COMPOUNDS IN GROUNDWATER AND LEACHATE AT WISCONSIN LANDFILLS.
Wisconsin Dept. of Natural Resources, Madison. Bureau of Solid Waste Management.
For primary bibliographic entry see Field 5B.
W89-11891

PROCEEDINGS OF THE FIFTH CORPS CHEMISTS MEETING, 17-18 MAY 1988.
Army Engineer Waterways Experiment Station, Vicksburg, MS. Environmental Lab.
For primary bibliographic entry see Field 5A.
W89-11893

HAZARDOUS AND TOXIC MATERIALS: SAFE HANDLING AND DISPOSAL.
John Wiley and Sons, New York. 1988. 514 p. Edited by Howard H. Fawcett.

Descriptors: *Hazardous wastes, *Waste disposal, *Waste management, *Regulations, *Toxicity, Legislation, Delaware River, Water pollution control, Oil spills.

The growing awareness and uneasiness of the public sector about hazardous and toxic chemicals and related materials has created a strong determination by legislators at national, state and local levels to attempt to control these chemicals by laws and regulations. This book combines the research of several experts, all presenting a positive viewpoint that hazardous and toxic chemicals and related materials can be controlled and disposed of without adverse effects on people, the environment, or future generations. Thirteen experts offer their views, research, and latest findings on a wide range of topical issues, including the Toxic Substances Control Act, SARA, long-term toxicity, the Delaware River pollution problem, medical care and surveillance for hazardous waste workers, oil spills, aqueous foams, remediation of contaminated sites, facility siting, and safe transport of dangerous goods. (See W89-11899 thru W89-11903) (Lantz-PTT)
W89-11898

SHAD RETURN TO THE DELAWARE,
P. J. Wingate.
IN: Hazardous and Toxic Materials: Safe Handling and Disposal. John Wiley and Sons, New York. 1988. p 223-230, 1 fig, 6 ref.

Descriptors: *Water pollution control, *Water pollution sources, *Water quality control, *Delaware River, *Delaware Bay, *Estuaries, *Shad, Oysters, Fisheries, Water pollution effects, Environmental effects, Ecological effects, Municipal wastes, Detergents, Pesticides, Industrial wastewater, Dye industry wastes, Flushing, Wastewater treatment, Activated carbon, Water pollution control, Environmental protection, Rehabilitation.

In 1920, shad were so plentiful in the Delaware that they were an important source of food for hundreds of thousands of people. Oysters were also a plentiful crop in the bay. From the Atlantic Ocean to Philadelphia via the Delaware River and Delaware Bay is only 100 miles. This body of water has perhaps better natural cleansing facilities than any other major estuary in the United States. Nevertheless, during the past three-quarters of a century, it became substantially more contaminated than estuaries such as the Chesapeake, and both shellfish and finfish, as well as other types of marine life suffered more in the Delaware. The municipalities along the Delaware have never fully cleaned up the wastewaters that all cities and towns generate, and some of the smaller towns and villages have done no cleanup at all. Detergents and other chemicals from millions of washing machines and dishwashers, as well as pesticides from farms and gardens, have added a heavy burden of pollution to the Delaware. For a period of nearly 40 years, the DuPont Company's Chambers Works was a significant contributor to pollution of both to the Delaware River and Delaware Bay. This was so because the Chambers Works was then producing slightly more than half of all the dyes being manufactured in the world, and dyes require more chemical intermediates than any other branch of organic chemistry. However, the Delaware has more recently benefited from the fact that the Chambers Works no longer manufacturers dyes and has installed what is probably the most efficient water--treatment facility in the world. The key element in the process is a patented procedure called 'PACT' (powder activated carbon technology), which uses carbon as a base for the growth of a complex strain of bacteria that will consume just about any organic chemical, except bacteriocides. Under pressure from a multitude of public forces, municipalities and hundreds, or perhaps thousands, of industrial concerns, large and small, along with millions of private homes, have made conscious efforts to reduce their flow of pollutants into the Delaware. The Delaware River and Delaware Bay have both responded well. Both are now considerably cleaner bodies of water than they were in 1970, and both are considerably more hospitable to all forms of marine life than 10 years ago. Shad are doing much better in their recovery than oysters. (See also W89-11898) (Lantz-PTT)
W89-11899

SUPERFUND.
Environmental Protection Agency, Cincinnati, OH. Hazardous Waste Engineering Research Lab.
R. D. Hill.
IN: Hazardous and Toxic Materials: Safe Handling and Disposal. John Wiley and Sons, New York. 1988. p 281-307, 9 fig, 4 tab, 11 ref.

Descriptors: *Legislation, *Superfund, *Regulations, *Cleanup operations, *Hazardous wastes, Comprehensive Environmental Response Compensation and Liability Act, Standards, Water pollution treatment, Risk assessment, Public health, Environmental protection, Waste disposal.

In response to public concern over poor past disposal practices of hazardous wastes and the thousands of uncontrolled waste sites throughout the United States, in December 1980 Congress enacted the Comprehensive Environmental Response, Compensation and Liability Act, PL96-510, commonly known as CERCLA or Superfund. This Act was a result of the wide publicity that sites such as Love Canal, Valley of the Drums, and Stringfellow had received that made the public aware that uncontrolled hazardous waste sites were either causing harm to the public health and environment or were a potential threat. The Superfund Act was enacted in part because of the recognition that the Resource Conservation and Recovery Act, commonly referred to as RCRA or Solid Waste Act, provided a regulatory program for active hazardous waste facilities but not inactive sites. The Superfund Amendments and Reauthorization Act, PL 99-499, called SARA, were adopted October 17,1986. This Act established a new fund of $8.5 billion over a five-year period beginning January 1, 1987. Superfund defines a 'hazardous substance' as: (1) any substance designated as a hazardous pollutant under Section 311 of the Clean Air Act; (2) any toxic pollutant listed under Section 307(a) of the Clean Water Act; (3) any hazardous air pollutant listed under Section 112 of the Clean Air Act; (4) any hazardous waste under RCRA; (5) any imminently hazardous chemical substance or mixture with regard to which the EPA Administrator has taken action under Section 7 of the Toxic Substance Control Act (TSCA); and (6) any substance designated as hazardous under Section 102 of Superfund. 'Reportable quantities' have been promulgated for 442 hazardous substances based on scientific criteria relating to the risk posed by a release of that substance. The cornerstone of Superfund is the National Contingency Plan (NCP). The plan establishes the procedures, and standards, for responding to releases of hazardous substances, pollutants, and contaminants. In addition, it contains the National Priority List (NPL) which indicates those sites that present the greatest danger to public health. Removal actions are undertaken when the EPA determines that there is a threat to public health or welfare or the environment. SARA places a limit on removal actions of $2 million and/or the lapse of 12 months from the date of the initial removal, unless it is found that circumstances warrant continued action. (See also W89-11898) (Lantz-PTT)
W89-11900

PREVENTION AND CONTROL OF OIL AND HAZARDOUS-MATERIAL SPILLS.
Texas A and M Univ., College Station. Dept. of Civil Engineering.
R. W. Hann.
IN: Hazardous and Toxic Materials: Safe Handling and Disposal. John Wiley and Sons, New York. 1988. p 309-335, 10 fig, 4 tab, 4 ref.

Descriptors: *Water pollution control, *Oil spills, *Hazardous materials, *Waste management, *Decision making, *Water pollution prevention, *Oil spills, *Hazardous wastes, Management planning, Environmental protection, Environmental policy, Risk assessment, Decision making, Cleanup operations.

Basic elements of the prevention and control of oil and hazardous material spills are presented and inter-related with the probability of harm equation for evaluating environmental risk. A major focus of the chapter is in the elements of contingency planning and related spill-response and resource acquisition is emphasized. Special emphasis is placed on making response decisions based on environmental considerations, evaluating response sources, and using cooperative resources. In considering response activities, an inter-related priority table of typical response priorities is presented for both hazardous material spills and for oil spills. Special lessons relating to reasonableness of response and cost of response ae presented to aid the responder in making judgement decisions. Technical aspects of the response are presented in the form of traditional and specialized resources and the reader is shown how these resources can be linked through unit operations and processes to apply them to the needs of spill response. (See also W89-11898) (Lantz-PTT)
W89-11901

INNOVATIVE ON-SITE TREATMENT/DESTRUCTION TECHNOLOGIES FOR REMEDIATION OF CONTAMINATED SITES.
URS Consultants, Inc., Long Beach, CA. Solid and Hazardous Waste Management Programs.
For primary bibliographic entry see Field 5E.
W89-11902

ANALYSIS OF TECHNICAL ISSUES RELATED TO REAUTHORIZATION OF THE CLEAN WATER ACT.
For primary bibliographic entry see Field 6E.
W89-11906

PROJECT AQUARIUS: AREAWIDE WATER QUALITY MANAGEMENT PLAN FOR EL PASO AND TELLER COUNTIES.
Pikes Peak Area Council of Governments, Colorado Springs, CO.
Field Enterprises Inc., 1974. 308p, 36 fig, 68 tab, 69 ref.

Descriptors: *Regional planning, *Project Aquarius, *Water quality management, *Management planning, *Colorado, Water pollution sources, Monitoring, Water pollution prevention, Water quality control, Wastewater treatment, Water supply.

The 1972 Federal Water Pollution Control Act amendments provide for a reasoned, area-wide approach to the abatement of water pollution through Section 208. The basic idea is that water pollution takes no notice of political jurisdictions and has many facets. Therefore, it is best examined in as comprehensive a way as possible, by an agency that has an overall planning responsibility. There is much to recommend in this approach and a major national program has been developed. In May of 1974 the Pikes Peak Area Council of Governments was designated as the planning agency to develop an areawide waste treatment management plan for El Paso and Teller Counties, in accordance with Section 208 of the Federal Water Pollution Control Act Amendments of 1972. The two year planning project was given the name 'Project Aquarius'. This report contains the recommended plan of implementation and was developed from the consensus of the citizens and their elected officials who participated in the many meetings and workshops. Planning boundaries for the project are: (1) water sources to be protected; (2) the location of significant discharges; and (3) the location of monitoring systems. (Lantz-PTT)
W89-11907

LIABILITY FOR AND CLEANUP OF OIL AND HAZARDOUS WASTE: LEGAL AND TECHNICAL ANSWERS TO A COMPLEX QUESTION.
Nutter, McClennen and Fish, Boston, MA.
For primary bibliographic entry see Field 6E.
W89-11924

POTENTIAL NITRATE CONTAMINATION OF SHALLOW GROUND WATER FOLLOWING CHEMICAL REHABILITATION OF A SEPTIC SYSTEM.
Illinois Univ., Urbana. Dept. of Agronomy.
For primary bibliographic entry see Field 5B.
W89-11926

'MAINTAINING DISPLACEMENT INTEGRITY AS AN INSTALLATION PROCEDURE' (AND IT'S EFFECTS ON ENVIRONMENTAL MONITORING).
Chama Corp., Roanoke, IN.
M. D. Geeting.
IN: Proceedings of the FOCUS Conference on Eastern Regional Ground Water Issues, September 27-29, 1988, Stamford, Connecticut. National Water Well Association, Dublin, Ohio, 1988. p 205-214, 3 fig.

Descriptors: *Underground storage, *Water pollution prevention, *Drilling, Groundwater quality, Construction methods, Observation wells, Wells, Backfill, Corrosion control.

Federal EPA regulations concerning underground storage tanks will include: retro-fitting existing tanks with observation wells as an alternative method of detecting leakage, and the installation of cathodic protection to reduce corrosion. Conventional methods of drilling to install these items in or near the tank backfill area, present the danger of drilling through or damaging the tank, and its associated plumbing. The free flow of backfill, the layering effect of existing ground conditions, and the existence of groundwater, etc., all play a part in creating underground cavities and reducing the compaction when the boring removal is done by the open flight auger method. Collapsed paving and/or broken plumbing, will eventually create problems for both the drilling contractor and the property owner. A new method has been developed using a completely enclosed auger, in a patented process, which is designed to displace only the amount of spoil from the borehole as is being replaced by the volume of the casing being installed in the process. Drilling risks are reduced by incorporating a tapered cutting head, with a two inch leading edge (for 4 in. PVC wells), which is the only exposed moving part. The resulting borehole is only approximately one half the diameter required by conventional drilling methods. Using this new method, it is possible to install observation wells and cathodic protection devices with the confidence that the integrity of the underground compaction is undisturbed. (See also W89-11916) (Author's abstract)
W89-11928

ABANDONMENT OF GROUNDWATER MONITORING WELLS AT THE SAVANNAH RIVER PLANT, AIKEN, SOUTH CAROLINA.
Du Pont de Nemours (E.I.) and Co., Aiken, SC. Savannah River Plant.
C. L. Bergren, J. L. Janssen, and J. D. Heffner.
IN: Proceedings of the FOCUS Conference on Eastern Regional Ground Water Issues, September 27-29, 1988, Stamford, Connecticut. National Water Well Association, Dublin, Ohio, 1988. p 215-220.

Descriptors: *Abandoned wells, *Savannah River Plant, *Monitoring, *South Carolina, *Groundwater quality, *Water quality control, *Observation wells, Savannah River, Boreholes, Drilling, Geohydrology, Wells, Cost analysis.

Many groundwater monitoring wells previously installed at the Savannah River Plant have become obsolete and need to be abandoned. Reasons for well abandonment include: (1) deterioration due to aging; (2) outdated installation methods; and (3) changes in land use requirements. Proper removal of these wells reduces the possibility of the downward migration of contaminants and resulting regulatory liability. Ordinarily, abandonment begins with removal of the casing, screen, and old grout from the borehole. It is completed by filling the reamed hole with neat cement. Several techniques may be used to remove the casing and screen material. Two methods commonly used are: (1) reaming/drilling out PVC-cased wells; or (2) over-reaming and extraction of steel-cased wells. The depth of the well, type of construction materials, grout quality, and vertical deviation determine the type of abandonment method to be used. Selection of the proper equipment and drill bit configuration are essential for successful abandonment. Geological information can also be obtained during well

abandonment by conducting downhole geophysical surveys. Proper abandonment is an essential, but frequently overlooked, part of a groundwater monitoring program. An abandonment program can improve cost effectiveness and reduce potential environmental liabilities. (See also W89-11916) (Author's abstract)
W89-11929

REDUCTION OF VOLATILE ORGANIC COMPOUND LEVELS IN SOILS AND GROUND WATER USING IN-GROUND SOIL VENTING.
IEP, Inc., Northborough, MA.
L. Robitaille, and S. K. Walen.
IN: Proceedings of the FOCUS Conference on Eastern Regional Ground Water Issues, September 27-29, 1988, Stamford, Connecticut. National Water Well Association, Dublin, Ohio, 1988. p 249-272, 11 fig, 5 ref.

Descriptors: *Water pollution treatment, *Volatile organic compounds, *Soil contamination, *Groundwater pollution, *Venting, *Water pollution prevention, Water pollution control, Benzene, Toluene, Xylenes, Case studies, New Jersey, Massachusetts, Cleanup operations, Soil gases.

Previous studies have indicated that soil venting was efficient at removing adsorbed volatile organic compounds (VOCs) such as benzene, toluene, and xylene from soils in the unsaturated zone at sites where gasoline leaks or spills had occurred. Two case studies were reviewed as part of this study to determine the effectiveness of soil venting at remediating soils contaminated with gasoline and at indirectly reducing dissolved VOC levels in groundwater. Remedial action at both sites is in its early stages, but it was determined that both venting operations are in effect drawing soil vapor from the entire areas of contamination at both sites. A small reduction in the venting system influent concentration has occurred at the Massachusetts site while the levels have not yet stabilized at the New Jersey site. VOC levels in groundwater have been reduced almost in half prior to the start of the system at both locations. It is anticipated that by the middle of September 1988, a reduction in VOC levels in soil and groundwater will clearly demonstrate the effectiveness of soil venting as a cleanup tool where VOCs, such as gasoline, have been spilled. (See also W89-11916) (Lantz-PTT)
W89-11931

MULTIOBJECTIVE ANALYSIS OF A COMPLEX AQUIFER SYSTEM CONTAMINATED WITH DENSE CHLORINATED HYDROCARBONS AND HEAVY METALS.
HMM Associates, Inc., Concord, MA.
For primary bibliographic entry see Field 5B.
W89-11932

CREATION OF AN ARTIFICIALLY PRODUCED FRACTURE ZONE TO PREVENT CONTAMINATED GROUNDWATER MIGRATION.
Dunn Geoscience Corp., Albany, NY.
K. F. Begor, and R. W. Sutch.
IN: Proceedings of the FOCUS Conference on Eastern Regional Ground Water Issues, September 27-29, 1988, Stamford, Connecticut. National Water Well Association, Dublin, Ohio, 1988. p 301-312, 6 fig, 1 tab.

Descriptors: *Fracture permeability, *Solute transport, *Aeration zone, *Groundwater pollution, *Water pollution prevention, *Path of pollutants, Aquifers, New York, Groundwater movement, Observation wells.

Fractured bedrock aquifers present some unique problems with regard to remediation. The most common problem typically stems from the inability to adequately characterize the secondary porosity network that provides the major avenues for contaminant transport. Insufficient characterization leads to difficulties in properly placing recovery wells and in verifying the effectiveness of the recovery system. To overcome these difficulties, an innovative approach involving the creation of an artificial fracture zone was developed at a site in Upstate New York. A contaminated groundwater plume was discovered to be migrating through the fractured sandstone aquifer underlying the site. An initial 72-hr aquifer test was performed to aid in designing a recovery well network. Results of the test indicated poor interconnection of the naturally occurring fractures. It was decided that by creating an artificial fracture zone, using controlled blasting techniques interconnection of the natural fracture network could be attained. A recovery well(s) installed within the artificial fracture zone could then be used to withdraw contaminated groundwater and thereby create an effective hydraulic barrier along the entire length of the fracture zone. Using a carefully controlled single line pattern blasting technique, a 6-ft wide, 300-ft long fracture zone was created in the upper 25-ft of the bedrock aquifer perpendicular to the centerline of the plume. Following fracturing, a second 72-hr aquifer test was conducted. The second test indicated that the single recovery well located in the newly created fracture zone should be fully capable of recovering contaminated groundwater and preventing further migration of the plume. The reinstalled recovery well produced a substantially higher yield as a result of the increased hydraulic interconnection. Furthermore, all of the nearby observation wells showed significant response to pumping. (See also W89-11916) (Author's abstract)
W89-11933

CAPTURE ZONE DESIGN USING SIMULATION MODELS AND OPTIMIZATION TECHNIQUES.
Connecticut Univ., Storrs. Environmental Research Inst.
D. P. Ahlfeld, and C. S. Sawyer.
IN: Proceedings of the FOCUS Conference on Eastern Regional Ground Water Issues, September 27-29, 1988, Stamford, Connecticut. National Water Well Association, Dublin, Ohio, 1988. p 313-323, 7 fig, 1 tab, 8 ref.

Descriptors: *Simulation analysis, *Water pollution treatment, *Groundwater pollution, *Cleanup operations, Groundwater movement, Aeration, Model studies, Costs, Mathematical models, Optimization.

A computational methodology for capture zone design for contaminated groundwater remediation is described. This method has been implemented in a computer model which utilizes both simulation and optimization techniques. The procedure determines the well locations and pump rates which will produce a desired groundwater flow field at minimum cost. In this paper, the theoretical basis for the design procedure is described, along with an example of its use on a hypothetical aquifer system. Numerical experiments are presented which attempt to determine the effect on the best solution of providing the model with different choices for locating wells. It is found that different well locations can have a major impact on the overall cost of remediation. (See also W89-11916) (Author's abstract)
W89-11934

HIGHWAY DEICING SALT CONTAMINATION PROBLEMS AND SOLUTIONS IN MASSACHUSETTS.
Massachusetts Dept. of Public Works, Lexington. Research and Materials Section.
For primary bibliographic entry see Field 5B.
W89-11937

EVALUATING HOMEOWNERS' GROUND WATER TREATMENT OPTIONS.
Pennsylvania State Univ., University Park. Dept. of Agricultural Economics and Rural Sociology.
For primary bibliographic entry see Field 5F.
W89-11938

GROUNDWATER PROTECTION INITIATIVES FOR THE PUBLIC DRINKING WATER SUPPLY IN THE TOWN OF CHESHIRE, CONNECTICUT.
South Central Connecticut Regional Water Authority, New Haven.
For primary bibliographic entry see Field 6E.
W89-11940

GROUND WATER RISK MANAGEMENT ON CAPE COD: THE APPLICABILITY OF GEOGRAPHIC INFORMATION SYSTEM TECHNOLOGY.
Environmental Protection Agency, Boston, MA. Region I.
For primary bibliographic entry see Field 4B.
W89-11941

SUFFOLK COUNTY WATER AUTHORITY WATERSHED PROTECTION STRATEGY.
Suffolk County Water Authority, Oakdale, NY.
For primary bibliographic entry see Field 6A.
W89-11942

DETERMINATION OF SAFE YIELD FOR PUBLIC SUPPLY WELL FIELDS IMPACTED BY SALT-WATER UPCONING IN EASTERN LONG ISLAND.
Leggette, Brashears and Graham, Inc., Wilton, CT.
For primary bibliographic entry see Field 4B.
W89-11943

CHALLENGES IN CREATING A LOCAL GROUNDWATER PROTECTION PLAN.
Housatonic Valley Association, Cornwall Bridge, CT.
For primary bibliographic entry see Field 4B.
W89-11944

WATER POLLUTION CONTROL IN LOW DENSITY AREAS: PROCEEDINGS OF A RURAL ENVIRONMENTAL ENGINEERING CONFERENCE.
September 26-28, 1973, Warren, Vermont. University Press of New England, Hanover, New Hampshire, 1975. 498p. Edited by William J. Jewell and Rita Swan.

Descriptors: *Water supply, *Water treatment, *Rural areas, *Wastewater treatment, *Water pollution control, *Water quality control, Nonpoint pollution sources, Solid waste disposal, Septic tanks, Septic wastewater, Groundwater pollution, Drinking water, Land use, Regulations, Waste disposal.

The water and land environmental problems associated with rural America are surprisingly large scale, and include: wastewater treatment and disposal of septic sludges in rural areas; groundwater quality control and supply; rural water supplies; and the quantity of pollutants discharged into drinking water supplies from both point and nonpoint sources. These problems are further compounded by the lack of laws and highly organized political units or special-interest groups with strong powers to protect this sector of the population. And the problems associated with low density areas can be expected to accelerate in the future as the population continues to spread from the large cities. Finally, the use of land as a waste disposal mechanism is rapidly taking on new significance. With the no-discharge regulations of the new pollution control laws, land disposal must be considered as a major waste treatment and disposal alternative. This alternative is discussed by a number of authors in this publication. The papers presented in this volume all attempt to bring experience and knowledge to bear on one of the most neglected areas in terms of environmental quality control--the rural environment. (See W89-11954 thru W89-11982) (Lantz-PTT)
W89-11953

WATER AND LAND ORIENTED WASTEWATER TREATMENT SYSTEMS.
Corps of Engineers, New York. Special Studies Branch.
For primary bibliographic entry see Field 5D.
W89-11954

WATER QUALITY AND SOLID WASTE PROBLEMS IN RURAL NEW MEXICO AND SOME SOLUTIONS.
Environmental Improvement Agency, Tesuque, NM. Water Supply Div.
J. R. Wright.
IN: Water Pollution Control in Low Density Areas: Proceedings of a Rural Environmental Engineering Conference, September 26-28, 1973, Warren, Vermont. University Press of New England, Hanover, New Hampshire, 1975. p 217-225.

Descriptors: *Rural areas, *Water quality control, *Solid wastes, *Wastewater disposal, New Mexico, Legislation, Regulations.

The geography of New Mexico ranges from high Alpine forest to lower Sonoran Desert. The water resources of the state cannot provide sufficient irrigation. About 3 million acre-ft of water from rainfall appear yearly as runoff in New Mexico streams, and an additional 2.5 million acre-ft are received from other states. Environmental problems affecting, and proposed solutions for, New Mexico water supplies are: water supply, sewage disposal, and solid waste. Legislative and regulatory advances toward the problem have addressed the water quality and sewage waste disposal problems. Solid waste problems in New Mexico are significant. In 1972, a bill was introduced in the state legislature to provide 50% state support to communities under 5,500 to purchase equipment and develop proper landfill sites. The bill, however, failed to pass the legislature. The 1973 session of the legislature provided $6 million for sewage disposal construction and $1.5 million for water supply construction, but turned down the solid waste proposal. Again, public interest in safe water supply was keen and helped sell the water bill. The sewage disposal program was already well established. (See also W89-11953) (Lantz-PTT)
W89-11971

NON-POINT POLLUTION SOURCES AND CONTROL.
Cornell Univ., Ithaca, NY. Environmental Studies Program.
For primary bibliographic entry see Field 5B.
W89-11974

WATER QUALITY IMPROVEMENT THROUGH CONTROL OF ROAD SURFACE RUNOFF.
Woodward-Clyde Consultants, San Francisco, CA. Envicon Div.
J. D. Sartor, and G. B. Boyd.
IN: Water Pollution Control in Low Density Areas: Proceedings of a Rural Environmental Engineering Conference, September 26-28, 1973, Warren, Vermont. University Press of New England, Hanover, New Hampshire, 1975. p 301-316, 2 fig, 7 tab, 3 ref. EPA Project No. 11034 FUJ.

Descriptors: *Cleanup operations, *Water pollution control, *Urban runoff, *Street cleaning, *Water quality control, Chemical oxygen demand, Glass, Plastics, Organic matter, Sand, Silt, Highways.

During the past few years, it has become increasingly obvious that runoff from storms is by no means 'rainwater' in terms of quality. Rather, storm runoff typically contains substantial quantities of impurities, so much so that it is a more serious source of pollutants than municipal sewage in many areas. Runoff can contribute to a variety of problems, including direct pollution of receiving waters, overloading of treatment facilities, and impairment of sewer and catch basin functions. These problems are caused in part by hydraulic overloading, but also by the various pollutants contained within the runoff. Most of the contaminant material was found to be inorganic, mineral-like matter, similar to common sand and silt. The origin of this material is extremely diverse and could not be established with certainty. On both a weight and volume basis, most of it appears to be soil that has been transported and deposited on the street. Fragments of glass, plastic, paper, and plant foliage are also abundant, as are rubber, metals, and asbestos. A great portion of the overall pollutional potential is associated with the fine solids fraction of the street surface contaminants. Chemical oxygen demand (COD) tests provide a good basis for estimating the oxygen demand potential the quantity of contaminant material at a given test site was found to depend upon the length of time which had elapsed since the site was last cleaned. Street surface contaminants are not distributed uniformly across the streets; to achieve better than 50% removal of the dust and dirt fraction of street surface contaminants, several times the normal street cleaning effort would have to be expended. Specially conducted field studies indicated that catch basins as normally used are reasonably effective in removing coarse inorganic solids from storm runoff, but are ineffective in removing the fine solids which contribute most heavily to water pollution. Better street cleaning operations and training for the operators of street cleaning equipment are needed to improve the quality of urban runoff. (See also W89-11953) (Lantz-PTT)
W89-11975

WATER QUALITY MANAGEMENT PLAN NORTH SEA: FRAMEWORK FOR ANALYSIS.
Waterloopkundig Lab. te Delft (Netherlands).
R. Koudstaal.
A. A. Balkema, Rotterdam, The Netherlands. 1987. 132p.

Descriptors: *Coastal waters, *Water quality control, *North Sea, *Water quality management, The Netherlands, Marine environment, Management planning, International waters, Marine resources, Legal aspects, Institutional constraints, Data interpretation, Data storage and retrieval.

The increased level of sea-based human activities and the increased volume of wastes discharged into a specific, geographically defined coastal water region, such as the North Sea, result: in increased competition between activities for limited space; often in undesired effects on the marine ecosystem, with corresponding adverse effects on human and human activities; and in under or over utilization of valuable resources. In such situations, governments should perform a major role in the management of marine resources. This report is one of the background documents of the Dutch North Sea water quality management plan. Chapter 2 gives a general introduction to marine resources management and discusses the basic concepts of the marine resources management system, planning, and framework for analysis. Chapter 3 describes the general nature of the North Sea management problem through an introduction on the main characteristics of the natural system, the utilization of the marine resources, and the legal and institutional context. Chapter 4 focuses on the water quality management of the Dutch portion of the North Sea. It describes the goal of the planning for water quality management, the perceptions of ambient water quality problems, the analysis conditions, and the framework for analysis adopted. Chapter 5 describes the methods of analysis used, including a description of the method used to evaluate the effect of ambient water quality on the marine ecosystem, while Chapter 6 presents the results of the analyses. Annex A describes a coastal water data management system (COWADAT), which was developed during the preparation of the water quality management plan for the North Sea, but is set up for a more general application for other coastal water management regions. (Lantz-PTT)
W89-11995

MANAGEMENT OF TOXIC MATERIALS IN AN INTERNATIONAL SETTING: A CASE STUDY OF CADMIUM IN THE NORTH SEA.
Waterloopkundig Lab. te Delft (Netherlands).
L. Dekker, B. T. Bower, and R. Koudstaal.
A. A. Balkema, Rotterdam, The Netherlands. 1987. 116p.

Descriptors: *International waters, *Water quality control, *Cadmium, *Water quality management, *North Sea, Sediment contamination, Marine environment, Exploitation, Management planning, Case studies, The Netherlands, Natural resources, Environmental quality.

This report is one of the products of the Analyzing Biospheric Change (ABC) Program sponsored by the International Federation of Institutes for Advanced Study (IFIAS). The ABC Program was established in 1981 with the objective of adding to knowledge of how to manage natural resources such that exploitation of those resources can be done while simultaneously maintaining or improving ambient environmental quality and living standards. Cadmium was chosen for this study because of: (1) increasing concern for potentially adverse, long-run effects of heavy metals such as cadmium; (2) the existence of a European Community (EC) directive on cadmium, one of the six substances for which directives on pollution of the aquatic environment have been adopted by the EC; and (3) the recommendation in the Dutch Water Quality Management Plan (WQMP) North Sea to pay additional effort to the elimination of cadmium discharges, on top of actions which already had been planned. To provide a basis for discussion of analysis procedure, a description of the Dutch WQMP-North Sea study is presented: Chapter 3--contains the background of and objectives for the study, and the approach; Chapter 4--the methods for estimating discharges of cadmium in 1980 from the various sources are described. The estimated quantities are also shown; Chapter 5--describes the methods for estimating the effects of the 1980 discharges on ambient water quality and on quality of sediments. Institutional actions in relation to the set of questions posed in Chapter 2 are analyzed in Chapter 6, in relation to both national and international institutions. Primary attention is given to the actions of the Dutch government and the effects of those actions. Because the approach in the Dutch study was considered to be inadequate in terms of generation of information for national and international decisions, a more adequate framework for analysis is presented in Chapter 7. Concluding observations and continuing questions are presented in Chapter 8. (Lantz-PTT)
W89-11996

WATER QUALITY MANAGEMENT FOR RESERVOIRS AND TAILWATERS. REPORT 1: IN-RESERVOIR WATER QUALITY MANAGEMENT TECHNIQUES.
Kent State Univ., OH. Dept. of Biological Sciences.
G. D. Cooke.
Available from the National Technical Information Service, Springfield, VA 22161. Technical Report E-89-1, January 1989. Report 1 of a Series. 182p, 14 fig, 19 tab, 461 ref.

Descriptors: *Reservoir operation, *Water quality control, *Reservoirs, *Water quality management, *Tailwater, Eutrophication, Biological treatment, Phosphorus, Wastewater disposal, Flushing, Aeration, Herbicides, Algicides, Chemical treatment.

Human influences threaten the quality of reservoirs, and appropriate protection and enhancement methods must be developed. Of particular concern are the consequences of eutrophication. Elevated nutrient concentrations, rooted plant infestations, reduced transparency, excessive algal growth, reduced dissolved oxygen concentrations in bottom waters, and elevated concentrations of organics in finished drinking water are symptoms of this process. Available in-reservoir methods for the management of these eutrophication-related problems are reported here, including: prereservoir treatment, phosphorus inactivation, dilution and flushing, sediment removal, hypolimnetic aeration, artificial circulation, water level drawdown, harvesting, biological controls, sediment covers, and herbicides and algicides. Also described are methods for problem diagnosis and the selection of appropriate methods. (Lantz-PTT)
W89-11997

HWHM 88: HAZARDOUS WASTES AND HAZARDOUS MATERIALS.
For primary bibliographic entry see Field 5E.
W89-12002

CONSTRUCTION AND QUALITY ASSESSMENT OF THE IN SITU CONTAINMENT OF CONTAMINATED GROUNDWATER.
GKN Hayward Baker Co., Odenton, MD.
G. K. Burke, and F. N. Achhorner.
IN: HWHM 88: Hazardous Wastes and Hazardous Materials. Proceedings of the 5th National Conference held April 19-21, 1988, Las Vegas, Nevada. 1988. p 6-10, 8 fig, 1 tab, 1 ref.

Descriptors: *Groundwater pollution, *Water pollution prevention, *Water pollution treatment, *Cleanup operations, Construction, Geohydrology, Stratigraphy, Path of pollutants, Filtration, In situ treatment, Groundwater barriers.

Since the discovery of industrial solvents in the soil and groundwater of its Mountain View, California facility in 1982, Raytheon Semiconductor has conducted an exhaustive investigation to identify and evaluate the extent of existing contamination, to identify and implement the most effective method of preventing groundwater migration on and off the site, and to decontaminate groundwater within the site so that the site eventually can be considered non-hazardous. Highly complex interbedded site stratigraphy, known multiple contaminant source from both on and off the site and the need for the plant to remain fully operational at all times, led to the construction of a soil-bentonite barrier wall, functioning in conjunction with a groundwater extraction and filtration system, as the best method to remedy all concerns. Key items which provided for successful and timely completion of the project, were barrier wall selection, maintenance of facility operations, organization and communications, preconstruction plans for control of the work, and quality assurance/quality control throughout construction. (See also W89-12002) (Lantz-PTT)
W89-12004

CAPTURE OF A GROUNDWATER CONTAMINATION PLUME IN FRACTURED BEDROCK BY AN ARTIFICIALLY PRODUCED FRACTURE ZONE CREATED THROUGH CONTROLLED BLASTING.
Dunn Geoscience Corp., Albany, NY.
K. F. Begor, R. W. Sutch, and F. A. Miller.
IN: HWHM 88: Hazardous Wastes and Hazardous Materials. Proceedings of the 5th National Conference held April 19-21, 1988, Las Vegas, Nevada. 1988. p 11-16, 6 fig, 1 tab.

Descriptors: *Water pollution prevention, *Groundwater pollution, *Fracture permeability, *Aeration zone, *Path of pollutants, Aquifers, Bedrock, Geohydrology, Blasting, Geologic fractures, Observation wells.

Recovery of contaminated groundwater in a fractured bedrock system presents some unique problems. Typically, the most common problem occurs from the inability to characterize adequately the discrete fractures through which contaminants may be migrating. To overcome these difficulties at a site in Upstate New York, an innovative approach was developed. Site investigations delineated the extent of a groundwater contamination plume migrating within a fractured bedrock aquifer (Medina sandstone) which underlies approximately 15 ft. of glacial till. A 72-hr aquifer test involving one recovery well resulted in a low yield (3.5 gal/min with 20 ft of drawdown). Data collected from adjacent observation wells indicated poor interconnection among the naturally occurring fractures. It was decided that controlled linear blasting could provide the enhanced fracture interconnection necessary to successfully intercept the contaminated groundwater plume, which then would be captured and removed by judicious placement of recovery well(s) installed within the fracture zone. Using a carefully controlled single line pattern blasting technique, a 6-ft wide, 300-ft long fracture zone was created in the upper 25-ft of the bedrock aquifer perpendicular to the centerline of the plume. Following fracturing, a second 72-hr aquifer test was conducted at the same location and under conditions similar to the first test. The second test indicated that the single recovery well located in the newly created fracture zone should be fully capable of recovering contaminated groundwater and preventing further migration of the plume. The recovery well produced a substantially higher yield of 18.5 gal/min with only 11.2 ft of drawdown. (See also W89-12002) (Lantz-PTT)
W89-12005

SIMULATION OF GROUNDWATER FLOW CHARACTERISTICS BY FLOW AND MASS TRANSPORT MODELS.
New Jersey Dept. of Environmental Protection, Trenton. Div. of Solid Waste Management.
H. Erdogan, J. B. Wiley, and J. B. Hughes.
IN: HWHM 88: Hazardous Wastes and Hazardous Materials. Proceedings of the 5th National Conference held April 19-21, 1988, Las Vegas, Nevada. 1988. p 17-22, 10 fig, 3 tab, 3 ref.

Descriptors: *Water pollution prevention, *Landfills, *Simulation analysis, *Groundwater movement, *Hydrologic models, *Path of pollutants, Solid wastes, Flow profiles, Waste disposal, Mathematical models, Finite element method, Aquifers, Geohydrology.

Groundwater quality is the main concern in the design and development of solid waste disposal facilities. Groundwater is vulnerable to contamination, hard to monitor, difficult and expensive to clean up, and virtually non-renewable once seriously polluted. Geohydrological characteristics of the Gloucester County solid waste disposal facility site have been evaluated utilizing a three-dimensional mathematical model. The model was calibrated using field data that have been obtained from the monitoring wells and piezometers installed at the site. The finite element method, a numerical technique, is employed in the model to obtain a numerical solution to the groundwater flow equation. Based on simulated groundwater characteristics of the site, a network of monitoring wells has been installed around the facility to prevent contamination of the groundwater aquifer. Under the conditions employed in the hypothetical leak simulations, plumes from the hypothetical leaks along the boundary of the landfill would first travel vertically downward through the Hornerstown-Navesink Formation, and then move horizontally through the Mount Laurel-Wenonah Formation to the north-northeast of the property at an average rate of 0.8 ft/day. The plume simulations indicate that contamination stemming from an undetected landfill liner leak could affect four domestic supply wells and one agricultural well located to the north and northeast of the landfill property. The plume could reach the closest domestic well in a total travel time of about 31 yr. and the agricultural well in about 33.5 yr. Based on the results of the modeling study, a network of monitoring wells has been installed at the downgradient of the flow screened at the bottom of the Mount Laurel-Wenonah Formation, to monitor groundwater quality. Additional wells were located between the landfill boundary and the domestic and agricultural wells. These wells will be sampled on a quarterly basis. (See also W89-12002) (Lantz-PTT)
W89-12006

ISOLATION AND MITIGATION OF GROUNDWATER CONTAMINATION BASED ON GROUNDWATER MODELING TECHNIQUES: A CASE HISTORY.
Camp, Dresser and McKee, Inc., Atlanta, GA.
M. K. Leslie, R. C. Johnson, and J. E. Orban.
IN: HWHM 88: Hazardous Wastes and Hazardous Materials. Proceedings of the 5th National Conference held April 19-21, 1988, Las Vegas, Nevada. 1988. p 23-28, 9 fig, 1 tab.

Descriptors: *Site remediation, *Water pollution treatment, *Groundwater pollution, *Model studies, Case studies, Groundwater movement, Aquifers, Hydrologic models, Groundwater level.

Groundwater contamination by volatile organic compounds is widespread throughout the United States. The problem is of particular concern in areas where the groundwater is the sole source of potable water. In cases where area-wide groundwater contamination occurs, it can be difficult to pinpoint a source of contamination and even more difficult to isolate and remediate the source. A study describes an approach developed through the use of groundwater modeling to effectively isolate a localized area of groundwater contamination for remediation. The hydraulic portion of the model provides the velocity field for a compatible solute transport, Random-Walk code. This model portion computes the convective movement of particles representing a constituent mass and adds a random longitudinal and transverse step to account for longitudinal and transverse dispersion. The transport process is repeated over a large number of particles and a large number of steps to replicate the dispersion spreading process accurately and economically. The model was used to predict groundwater flow at the Hollingsworth Solderless Terminal Company (HSTC) Site in Fort Lauderdale, Florida, under various steady-state pumping scenarios. The modeled flow regimes were then used to estimate ranges for the duration of site remediation based on the minimum and maximum target areas for surficial groundwater decontamination. Steady-state conditions were imposed for the following reasons: (1) aquifer response to pumping (for the pumping rates envisioned) is such that steady-state water levels are reached within days of start-up; and (2) pumpage from/to wells is expected to be steady and continuous. (See also W89-12002) (Lantz-PTT)
W89-12007

CONTROL AND REMEDIATION OF VOLATILE ORGANIC CHEMICAL MIGRATION IN FRACTURED BEDROCK.
Jordan (Edward C.) Co., Inc., Portland, ME.
For primary bibliographic entry see Field 5B.
W89-12008

DESIGN AND OPERATIONAL CHARACTERISTICS OF A COLLECTION TREATMENT/RECHARGE/FLUSHING GROUNDWATER REMEDIATION SYSTEM.
PRC Environmental Management, Inc., Chicago, IL.
K. O. Thomsen, M. A. Chaudhry, and D. H. Schulz.
IN: HWHM 88: Hazardous Wastes and Hazardous Materials. Proceedings of the 5th National Conference held April 19-21, 1988, Las Vegas, Nevada. 1988. p 34-38, 6 fig, 1 tab.

Descriptors: *Site remediation, *Groundwater pollution, *Water pollution treatment, *Water pollution control, Groundwater recharge, Volatile organic compounds, Aquifers, Air stripping, Volatilization, Economic aspects.

Volatile organic compounds (VOCs) usually associated with spent solvent disposal were identified as contaminating an unconfined glacial outwash aquifer at a site in Michigan. As a result of a remedial investigation/feasibility study, a remedial action alternative was selected. The selected alternative included a combination of groundwater collection, treatment, recharge and soil flushing. The collection system withdraws groundwater from several levels in heavily contaminated areas. VOCs in the groundwater are removed in an air stripper. The effluent from the air stripper is spread in a recharge basin constructed over the most heavily contaminated areas using a spray distribution system. This recharge system removes additional contaminants by providing natural volatilization and percolating into the ground. Recharge water moves downward through the contaminated soils, flushing the residual soil contaminants, which are then recycled. This paper presents design and operational characteristics of the remedial action system, and an evaluation of the system's performance during its first season of operation, capital costs and the projected annual operation and maintenance costs. (See also W89-12002) (Author's abstract)
W89-12009

CASE HISTORY OF A CONTAMINATED GROUNDWATER DISCHARGE TO SURFACE WATER PURSUANT TO AN ACL.
Eder Associates, Locust Valley, NY.
G. A. Rozmus, and W. J. Cunningham.

IN: HWHM 88: Hazardous Wastes and Hazardous Materials. Proceedings of the 5th National Conference held April 19-21, 1988, Las Vegas, Nevada. 1988. p 39-44, 6 fig, 3 tab.

Descriptors: *Water pollution control, *Groundwater pollution, *Surface water, *Legislation, *Alternate Concentration Limit, Regulations, Volatile organic compounds, Resource Conservation and Recovery Act, Superfund, Leaching, Case studies.

The Alternate Concentration Limit (ACL) concept was used in a Comprehensive Environmental Response Compensation and Liability Act (CERCLA) 106 private party response to defend the continued discharge of contaminated groundwater to a river. Several closed facilities at this pre-Resource Conservation and Recovery Act (RCRA) site were leaching metals and VOCs to groundwater which discharged to a nearby river. The circumstances defining the discharge from this site match the conceptual ACL scenario described in US EPA's July 1987 ACL Guidance where the facility owns the property, the plume has reached surface water, the contaminants do not cause a statistically significant increase over background in the surface water and there are no receptors between the source and the surface water. These circumstances also satisfy the Superfund Amendments and Reauthorization Act (SARA) section 121(d) ACL exclusion requirements which include institutional measures to preclude contact with contaminated groundwater. As there was no directly applicable regulatory basis to defend the discharge of contaminated groundwater to a surface water body where the effect of the discharge could not be reliably measured, an argument justifying the discharge was tied to the RCRA 40 CFR 264.94(b) discussion of alternate concentration limits as a groundwater quality issue. EPA did not question the logical basis of this argument extending the RCRA ACL concept to include a groundwater discharge to surface water, and it is now incorporated in EPA guidance, which recognizes the possibility of a managed discharge that has no public health or environmental impact. The managed discharge was acceptable to the State and it satisfied the intent of the State's regulations which allow closure with waste in contact with groundwater providing certain conditions are met. (See also W89-12002) (Lantz-PTT)
W89-12010

BASICS OF GROUNDWATER CONTAMINATION MODELING.
Camp, Dresser and McKee, Inc., Atlanta, GA.
For primary bibliographic entry see Field 5B.
W89-12011

IN SITU FLUSHING AND BIORECLAMATION TECHNOLOGIES AT A CREOSOTE-BASED WOOD TREATMENT PLANT.
Weston (Roy F.), Inc., West Chester, PA.
D. Dworkin, D. J. Messinger, and R. M. Shapot.
IN: HWHM 88: Hazardous Wastes and Hazardous Materials. Proceedings of the 5th National Conference held April 19-21, 1988, Las Vegas, Nevada. 1988. p 67-76, 10 fig, 3 tab.

Descriptors: *Groundwater pollution, *Site remediation, *Water pollution prevention, *Wood wastes, *Creosote, *Cleanup operations, *Bioreclamation, Containment, Costs, Path of pollutants, Economic aspects, Biodegradation.

The results of a remediation investigation/feasibility study (RI/FS) conducted at the L.A. Clarke wood treating site near Fredericksburg, Virginia, a site that covers approximately 40 acres and is situated upstream of Massaponax Creek and sensitive wetlands areas are reported. Plant practices have included the burial of free product which has resulted in relatively stationary pocketed areas of elevated polynuclear aromatic (PNA) concentrations. These PNAs have become the source of soluble contamination transported by infiltration to the groundwater table. The overall objective of this RI/FS is the identification of the most appropriate, cost-effective solutions for remediation of the site. Six remedial action alternatives were identified for the Clarke site: no action, extraction, in situ soil flushing/bioreclamation, land farming/biodegradation, containment, and off-site treatment/disposal. In situ flushing followed by in situ bioreclamation will directly address the sources of contaminant migration. Implementation of the in situ treatment alternative would first require the installation of injection/recovery wells in the creosote layer areas. In considering the cost effectiveness of various alternatives, the following were examined: (1) capital costs; (2) operating and maintenance costs; and (3) post remediation (monitoring) costs. The present worth value method (1987 dollars basis) was utilized to evaluate the total costs of a remedial action strategy including the post closure period. In situ soil flushing/bioreclamation was determined to be one of the most cost-effective alternatives. (See also W89-12002) (Lantz-PTT)
W89-12014

INDUSTRIAL PLANT EXPANSION: GROUNDWATER AND SOIL CLEANUP.
Sweet-Edwards/EMCON, Kelson, WA.
J. E. Edwards, and T. Bonham.
IN: HWHM 88: Hazardous Wastes and Hazardous Materials. Proceedings of the 5th National Conference held April 19-21, 1988, Las Vegas, Nevada. 1988. p 158-161, 7 fig.

Descriptors: Water pollution treatment, *Waste treatment, *Groundwater pollution, *Cleanup operations, *Pentachlorophenol, *Soil contamination, Chemical treatment, Filtration, Activated carbon, Barriers, Containment.

A floating plume of pentachlorophenol/mineral spirits was detected during preliminary soil testing for a major industrial plant expansion. After the leaking process tank was removed from service, subsequent geohydrologic investigation determined that the floating pentachlorophenol (PCP) product plume covered approximately 3 acres. The site is located adjacent to a mountain lake and has a seasonal water table < 10 ft below ground surface. Migration of the floating plume was restricted by a water table depression caused by a nearby basement sump pump. The dissolved PCP plume (< 10 micrograms/L) had migrated to the nearby canal and lake. The groundwater and soil cleanup plan was designed to allow construction of the plant over the floating product plume. The soil and groundwater were to be made non-toxic as defined by a state approved aquatic bioassay test. To achieve this cleanup goal, floating product recovery trenches were constructed adjacent to the footprint of the proposed building. The building foundation wall was then constructed while the groundwater treatment plant was being designed. The PCP/mineral solvent treatment system includes hydrogen peroxide/UV oxidation, mixed media filtration and an activated carbon polish. The system is designed to treat 30 gal/min continuous flow with 10 parts per million PCP influent. The treated groundwater is piped to a subsurface distribution trench located between the floating plume and the lake. The linear groundwater mound resulting from subsurface disposal of treated groundwater also acts as a hydrologic barrier to prevent migration of floating product to the lake. (See also W89-12002) (Author's abstract)
W89-12021

PRACTICAL APPROACH FOR THE BIOLOGICAL REMEDIATION OF HAZARDOUS WASTE SITES.
Bioprocess Engineering, Inc., Wilmington, DE.
A. F. Rozich, and T. G. Zitrides.
IN: HWHM 88: Hazardous Wastes and Hazardous Materials. Proceedings of the 5th National Conference held April 19-21, 1988, Las Vegas, Nevada. 1988. p 167-171, 6 fig, 8 ref.

Descriptors: *Water pollution treatment, *Groundwater pollution, *Biological treatment, *Waste treatment, *Cleanup operations, *Waste disposal sites, Hazardous wastes, Oxygen, Nitrogen, Hydrogen ion concentration, Land disposal, Phosphorus, CONTRAL, Algorithms, Model studies.

Background and some practical approaches are presented for the application of biological techniques for the remediation of hazardous waste sites. The basic engineering considerations for the biodegradation of hazardous materials include oxygen availability, nutrient (nitrogen and phosphorus) availability, pH and moisture, as well as the nature and physical characteristics of the target contaminants and their interactions with the environment. Evaluation of the biodegradation kinetics of the target contaminants also is essential, especially when using engineering algorithms for the design and operation of bioprocess systems. Three different biotreatment systems and examples of their application are described. Biostimulation is used to clean up groundwater and associated soils. Bioslurry is applied to the decontamination of sludges and highly contaminated (> 1%) soils. Biofarming, or landfarming, is used to remediate lightly (< 1%) contaminated soils. The application of bioreactor engineering for managing bioremediation systems, and the use of the CONTRAL bioprocess control algorithm, are discussed. This process design and operational algorithm uses predictive bioprocess models which are calibrated using respirometric measurements of biomass degrading the target waste. (See also W89-12022) (Lantz-PTT)
W89-12022

IN SITU TREATMENT AND REMOVAL OF AN ACIDIC COPPER PLATING WASTE SPILL FROM A FLOWING STREAM.
Environmental Protection Agency, Dallas, TX. Region VI.
J. C. Staves, and P. L. Hammack.
IN: HWHM 88: Hazardous Wastes and Hazardous Materials. Proceedings of the 5th National Conference held April 19-21, 1988, Las Vegas, Nevada. 1988. p 172-176, 4 fig, 12 ref.

Descriptors: *Water treatment, *In situ treatment, *Copper, *Metal-finishing wastes, Ash Creek, Texas, Flocculation, Filtration, Cleanup operations, Hydrogen ion concentration.

An in-stream treatment system consisting of an alum flocculation basin followed by a sand filter was developed to remove copper, resulting from a tank truck spill, from a 2-mile section of Ash Creek near Azle, Texas. The system was constructed from readily available materials in about six hours, and all contaminated water was treated within 24 hr. The copper removal efficiency approached 90% and varied with pH and alum addition rate. Optimal system performance occurred at a pH of 7.1 and an alum concentration of 1 gm/L. (See also W89-12002) (Author's abstract)
W89-12023

IN-PLACE PRECIPITATION IMMOBILIZATION: TECHNICAL AND ECONOMIC ASSESSMENT AT THE FORMER A.Y. MCDONALD FOUNDRY SITE, DUBUQUE, IOWA.
Notre Dame Univ., IN. Dept. of Civil Engineering.
J. A. Mundell, K. R. Hill, and J. W. Weaver.
IN: HWHM 88: Hazardous Wastes and Hazardous Materials. Proceedings of the 5th National Conference held April 19-21, 1988, Las Vegas, Nevada. 1988. p 177-181, 6 fig, 2 tab, 5 ref.

Descriptors: *Lead, *Chemical treatment, *In situ treatment, *Water pollution treatment, *Economic aspects, Heavy metals, Management planning, Costs.

Remedial action alternatives at hazardous waste sites containing significant concentrations of heavy metals have, in the past, concentrated on waste excavation and relocation to provide the most certain solution for site closure. The extent of waste removal has been guided mainly by the results of soil metal concentration guidelines or EP Toxicity test results. The results of a detailed evaluation of the technical and economic effectiveness of in-place precipitation immobilization (IPI) of lead at the former A.Y. McDonald foundry site in Dubuque, Iowa are presented. The complete assessment involved the consideration of six alternative remedial actions (no action; contour, topsoil; IPI, clay cap, and monitor; IPI, Resource Conservation and Recovery Act (RCRA) cap and monitor; par-

tial off-site removal, clay cap and monitor; and clean closure RCRA cap and monitor) on the basis of performance, reliability, ease of implementation, and safety. Site groundwater data suggest that there has been no significant lead migration into the groundwater under the plant because the presence of the lead carbonate mineral, cerrusite, is controlling the dissolved lead concentration to levels at or below the proposal EPA standard for drinking water. The collection of detailed subsurface geological and geochemical information as well as the performance of laboratory treatability studies were used to demonstrate that the use of IPI is significantly more cost-effective than either partial or complete removal alternatives at the site. The IPI technique also should provide a technically sound permanent solution for controlling lead release from the site to acceptable levels. (See also W89-12002) (Lantz-PTT)
W89-12024

SITE-SPECIFIC IN SITU TREATMENT PROCESS DEVELOPMENT PROGRAM FOR A WOOD PRESERVING SITE,
Union Pacific Railroad, Omaha, NE.
R. C. Kuhn, and K. R. Piontek.
IN: HWHM 88: Hazardous Wastes and Hazardous Materials. Proceedings of the 5th National Conference held April 19-21, 1988, Las Vegas, Nevada. 1988. p 182-186, 3 fig, 2 tab, 19 ref.

Descriptors: *In situ treatment, *Groundwater pollution, *Soil contamination, *Cleanup operations, *Wood wastes, Oil recovery, Industrial wastes, In situ tests, Bioreclamation.

Union Pacific Railroad is undertaking corrective action at a railroad tie treatment plant in Laramie, Wyoming. Contamination ranges from oil saturated sands and gravels to groundwater containing microgram/L levels of dissolved contaminants. A contaminant isolation system has been installed around the site. Corrective action is now focused on the use of in situ treatment techniques to remove and treat the subsurface contamination at the site. A program consisting of a series of laboratory and field pilot tests is being performed to determine the effectiveness of three in situ treatment technologies: oil recovery, in situ soil washing and in situ bioreclamation. Preliminary results and evaluations indicate that a combination of these in situ treatment techniques could be an environmentally sound, cost-effective approach for site cleanup. (See also W89-12002) (Author's abstract)
W89-12025

CONSTRUCTION QUALITY ASSURANCE FOR SAND-BENTONITE LINERS.
Ardaman and Associates, Inc., Orlando, FL.
For primary bibliographic entry see Field 5E.
W89-12027

HYDRAULIC CHARACTERISTICS OF MODEL SOIL-BENTONITE SLURRY CUTOFF WALLS.
Cincinnati Univ., OH. Dept. of Civil and Environmental Engineering.
R. M. McCandless, and A. Bodocsi.
IN: HWHM 88: Hazardous Wastes and Hazardous Materials. Proceedings of the 5th National Conference held April 19-21, 1988, Las Vegas, Nevada. 1988. p 198-201, 6 fig, 7 ref.

Descriptors: *Water pollution prevention, *Liners, *Linings, *Waste disposal, *Waste disposal sites, *Hydraulic properties, *Cutoffs, *Bentonite, *Soil compaction, Hydraulic gradient, Hydraulic conductivity, Fluid mechanics, Hazardous wastes, Groundwater pollution.

Model soil-bentonite cutoff walls which are commonly used to control or limit groundwater contaminants at hazardous waste sites, roughly 508 millimeters (mm) in diameter, 559 mm in height and 102 mm thick were constructed and tested in an instrumental tank. The effects of overburden pressure (vertical consolidation) and hydraulic gradient (horizontal consolidation) were investigated, followed by tests to evaluate the potential for closure of artificial windows representing small pockets of entrapped bentonite slurry in the backfill. The average hydraulic conductivity of the first model was measured for three hydraulic gradients under each of three applied overburden pressures. Decreases in conductivity were observed for incremental increases in both overburden pressure and hydraulic gradient as well as their combined effect. This test sequence was interrupted on two occasions by hydrofracture of the model. In the second wall, the closure of slot-like windows (macrodefects) by incremental increases in surcharge pressure was investigated. Despite the recurrence of hydrofracture in this case, it was possible to "heal' the window slots by elevating surcharge pressure and reconsolidating the model wall. The reconsolidation of both walls after hydrofracture produced roughly uniform water contents and dry densities over the full depth of the walls. In contrast, vane shear strength and cone penetrometer data for both walls were observed to decrease somewhat with increasing depth in the models apparently indicating variable degrees of damage due to hydrofracture corresponding with variable degrees of remolding during reconsolidation. The variable final strength profiles cannot be readily explained. The uniform water content and density profiles, however, indicate a uniform consolidation of the backfill and suggest that in situ consolidation of the backfill may serve to eliminate minor as-built or chemically-induced hydraulic defects in real slurry walls. (See also W89-12002) (Author's abstract)
W89-12028

DESIGN AND CONSTRUCTION OF EFFECTIVE SOIL LINERS.
Brown (K.W.) and Associates, Inc., College Station, TX.
D. C. Anderson, and M. C. Anderson.
IN: HWHM 88: Hazardous Wastes and Hazardous Materials. Proceedings of the 5th National Conference held April 19-21, 1988, Las Vegas, Nevada. 1988. p 202-204, 2 fig, 9 ref.

Descriptors: *Water pollution prevention, *Landfills, *Leachates, *Liners, *Soil water, *Hydraulic properties, Groundwater movement, Soil density, Permeability, Flow profiles, Soil water.

Almost all criteria currently used for the construction of compacted soil layers were developed to maximize density rather than to minimize permeability. Since there is no direct relationship between density and permeability, new criteria are needed for construction of low permeability soil liners. As was the case during the development of criteria for maximizing density, comprehensive field-scale studies are needed to determine the most appropriate construction criteria for minimizing permeability. In the simplest terms, the flow paths in soil liners can be grouped into intralift and interlift macropores. Intralift flow appears to arise largely from the incomplete remolding of clods, which results in macropores along the interfaces of clod remnants. Interlift flow is due to the inadequate bonding of adjacent lifts. In the absence of comprehensive field-scale studies, the only way to minimize these problems is through site-specific studies. These studies should be centered around a test fill, constructed with the identical soil, procedures and equipment proposed for the full-scale soil liner. A comprehensive construction quality assurance program also is essential to ensure that the parameters validated in the test fill are duplicated precisely during construction of the actual facility soil liner. (See also W89-12002) (Author's abstract)
W89-12029

ORGANIC FLUID EFFECTS UPON BENTONITE.
Bentec, Ferndale, MI.
G. R. Alther, J. C. Evans, and E. Andrews.
IN: HWHM 88: Hazardous Wastes and Hazardous Materials. Proceedings of the 5th National Conference held April 19-21, 1988, Las Vegas, Nevada. 1988. p 210-214, 1 fig, 4 tab, 21 ref.

Descriptors: *Groundwater barriers, *Water pollution prevention, *Leachates, *Bentonite, *Organic compounds, *Hydraulic conductivity, Permeability, Clays, Landfills.

The purpose of these studies was to determine the influence of organic fluid types and concentrations on Bentonite. For a wide range of organic fluids over a wide range of concentrations (provided that the concentration was below the solubility limit) solubilized organic fluids have limited detrimental impact upon the coefficient of hydraulic conductivity of bentonite. Certain concentrated organic fluids cause significant increases in the hydraulic conductivity of bentonite; several organic fluids actually reduced the hydraulic conductivity; and the filter press permeability test and the cracking pattern test may be used to quickly assess the potential effect of a fluid upon a clayey material. (See also W89-12002) (Author's abstract)
W89-12031

EVALUATION OF REMEDIAL ALTERNATIVES FOR AN INACTIVE INDUSTRIAL LANDFILL.
Weston (Roy F.), Inc., West Chester, PA.
R. M. Shapot, L. J. Bove, and M. Dzedzy.
IN: HWHM 88: Hazardous Wastes and Hazardous Materials. Proceedings of the 5th National Conference held April 19-21, 1988, Las Vegas, Nevada. 1988. p 215-219, 2 fig, 3 tab, 1 ref.

Descriptors: *Water pollution treatment, *Water pollution prevention, *Landfills, *Cleanup operations, *Waste management, Waste treatment, Economic aspects, Waste disposal, Incineration, Containment.

An evaluation of remedial alternatives is presented for a multi-use industrial site on the National Priority List (NPL). Waste disposal areas studied at the site include an inactive landfill containing various solid and chemical wastes and two former metal plating waste lagoons. The primary objectives of the remedial action (RI) were to determine the extent and sources of contamination, identify contaminant migration pathways and verify contaminant removal by previous remedial actions. An Endangerment Assessment also was prepared to evaluate the potential impacts on public health and the environment. The alternatives were developed and evaluated on a cost and non-cost basis: (1) no action; (2) in situ closure; (3) partial removal and containment; (4) on-site incineration with containment; (5) on-site incineration and disposal; and (6) removal/off-site option. Placement of a Resource Conservation and Recovery Act cap system on the landfill (alternatives 2, 3, and 4) may be complicated as a result of engineering requirements for slope stability of the cap as it relates to current site topography. The alternatives that include incineration (alternatives 4 and 5) may be more difficult to implement as a result of ash handling and disposal concerns and will require a test burn to confirm the design parameters. Alternative 5 includes incineration of the landfill materials, which will require presorting of the landfill contents prior to their being fed to the incinerator, resulting in additional implementation difficulties. Public health and environmental risks remain a concern under the no-action alternative. The remaining five alternatives should significantly reduce these risks. Institutional requirements, as well, are addressed under all options except the no-action alternative. This option fails to meet Superfund Amendments and Reauthorization Act of 1986 requirements for a cover or containment system. Present worth cost estimates for the remedial alternatives range from $787,000 for the no-action alternative to over $30,350,000 for the removal/off-site option. (See also W89-12002) (Lantz-PTT)
W89-12032

HANSCOM AFB HAZARDOUS WASTE DISPOSAL AREA CLEANUP.
Engineering-Science, Inc., Syracuse, NY.
J. P. McAuliffe, W. G. Christopher, L. Cordone, and E. B. Cohen.
IN: HWHM 88: Hazardous Wastes and Hazardous Materials. Proceedings of the 5th National Conference held April 19-21, 1988, Las Vegas, Nevada. 1988. p 245-250, 7 fig, 4 tab, 5 ref.

Descriptors: *Wastewater treatment, *Site remediation, *Hazardous wastes, *Waste disposal, *Clean-

up operations, Hanscom AFB, Groundwater pollution, Costs, Economic aspects, Groundwater recharge, Soil contamination, Waste treatment, Air stripping.

Remedial alternatives were developed for three disposal sites which were operated by the US Air Force (USAF) from the late 1950s through the early 1970s at Hanscom Field. One site is a former fire training area, while the other two are drum disposal areas. The two drum disposal sites contain an estimated 3,000 drums of waste fuel, paint and solvents disposed of in trenches and pits excavated to or below the groundwater table. Based on engineering feasibility, environmental effectiveness, public health protection, cost and negotiations with interested parties, the selected remedial alternative for the two drum disposal areas includes drum removal, recharge beds for enhanced flushing of contaminated soils, groundwater collection trenches and groundwater treatment via air stripping. The goal of the recharge beds (2.5 and 0.7 acres) is to enhance infiltration (by as much as 60 times) and expedite soil contaminant elutriation. The USAF fast-tracked the remediation process by accelerating the review process, by funding the preparation of separate plans and specifications and by awarding a separate contract for the immediate removal of the drums and highly contaminated soils. (See also W89-12002) (Lantz-PTT)
W89-12034

USING ACLS TO ESTABLISH REMEDIAL DESIGN GOALS.
Environmental Science and Engineering, Inc., Gainesville, FL.
For primary bibliographic entry see Field 6E.
W89-12035

STATUS OF 'SITE' PROGRAM DEMONSTRATIONS.
Environmental Protection Agency, Cincinnati, OH. Hazardous Waste Engineering Research Lab.
N. M. Lewis, and R. D. Hill.
IN: HWHM 88: Hazardous Wastes and Hazardous Materials. Proceedings of the 5th National Conference held April 19-21, 1988, Las Vegas, Nevada. 1988. p 256-260, 5 ref.

Descriptors: *Site remediation, *Water pollution treatment, *Superfund, *Field tests, Performance evaluation, Incineration, Heat treatment, Solidification, Stabilization, Biological treatment, Ion exchange.

In response to the Superfund Amendments for Reauthorization Act of 1986, the Office of Research and Development (ORD) and the Office of Solid Waste and Emergency Response (OSWER) have established the Superfund Innovative Technology Evaluation (SITE) program to accelerate the development and use of alternative technologies at Superfund sites. The SITE program will provide the opportunity to demonstrate new and innovative technologies, as well as provide assurance on performance data and cost information on those technologies. Since 1986, EPA has solicited requests for proposals three times. In 1986 (SITE-001) 21 responses were received and 10 technologies were selected for demonstration. The second solicitation (SITE-002) in 1987 received 29 responses. Of the 29 proposals, 11 were selected. The demonstration process on the SITE-001 1986 selected technologies began in 1987. The technologies were: (1) electric infrared furnace; (2) solidification and stabilization; (3) vacuum extraction; (4) oxygen enriched burner; (5) electric pyrolyzer; (6) circulating fluidized bed combustion; and (7) biological extraction. SITE-002 technologies went through a site selection process in January 1988 and demonstration plans for these technologies are being prepared. These technologies are: (1) biological; (2) extraction; (3) thermal; (4) ion exchange; and (5) solidification/stabilization. (See also W89-12002) (Lantz-PTT)
W89-12036

WINTERIZATION: CONSIDERATIONS AND EFFORTS.
SCS Engineers, Inc., Dublin, CA.
M. J. Griffin, R. A. Appleman, and T. E. Duaime.
IN: HWHM 88: Hazardous Wastes and Hazardous Materials. Proceedings of the 5th National Conference held April 19-21, 1988, Las Vegas, Nevada. 1988. p 261-263, 1 fig, 3 ref.

Descriptors: *Water pollution treatment, *Groundwater pollution, *Cold regions, *Cleanup operations, Hazardous wastes, Production wells, Heating, Wells.

Uncontrolled hazardous wastes resulting from abandoned wood treatment facilities have become an increasing environmental problem. Due to the nature of the wood treating industry, many of these sites are located in northern climates with adverse winter conditions. In these northern climates, the operation and maintenance of a year-round cleanup program presents special practical problems. Cleanup sites designed and constructed utilizing warm climate cleanup specifications may not always consider local cold climate engineering practices. During the 1985-86 year, the Montana Pole cleanup site, located in Butte, Montana, was shut down for the cold November to March period. Shut-down problems included numerous broken pipes and fittings and the loss of product (oil and pentachlorophenol) collection. By employing special winterization techniques in 1986-87, the cleanup system has been operated through the following 1-1/2 subzero winters, maintaining product collection. The winterization efforts at this site concentrated on the four following areas of the site: product production wells, control sheds, API oil/water separators and the decontamination trailer. Winterization procedures for the production wells during the second year of operation consisted of: attaching plywood panels to the steel tripods; attaching rigid styrofoam insulation to the plywood panels; installing a 250 watt heat lamp over the well; and heat taping and insulating the exposed product and air lines. Wood structures were made to protect the air compressor intake from the winter elements and vent covers were designed to limit air drafts at both control sheds. Heaters were used in each oil/water separator and set at 40 F. This heater appeared to solve the general problems but it was necessary to raise the temperature to 65 F to thaw the corners of the separator. In general, the system was ice free but skimming problems were still apparent during severe cold spells. The decontamination trailer was built using a construction trailer as a base. After the first winter, a 5000 watt heater was installed along with heat taping and insulating of outside drains. Plastic skirting and straw bales also were added to prevent further problems. (See also W89-12002) (Lantz-PTT)
W89-12037

SITE INSPECTIONS IN SUPPORT OF SUPERFUND'S REVISED PRE-REMEDIAL PROGRAM.
Ecology and Environment, Inc., Arlington, VA.
For primary bibliographic entry see Field 6A.
W89-12038

CONTAMINATION ASSESSMENT AND REMEDIAL ALTERNATIVES FOR FORMER WASTE OIL PROCESSING FACILITY CONTAMINATING THE BISCAYNE AQUIFER.
Ecology and Environment, Inc., Tallahassee, FL.
M. Trnovsky, K. Frantzen, and R. J. Rudy.
IN: HWHM 88: Hazardous Wastes and Hazardous Materials. Proceedings of the 5th National Conference held April 19-21, 1988, Las Vegas, Nevada. 1988. p 284-290, 9 fig, 4 tab, 1 ref.

Descriptors: *Oil industry, *Groundwater pollution, *Cleanup operations, *Heavy metals, *Biscayne Aquifer, *Water pollution treatment, Containment, Lead, Soil contamination, Chromium, Hydrocarbons, Incineration, Solidification, Superfund, Leaching, Saline water intrusion.

Contamination of soil and groundwater with organics and heavy metals was investigated and feasible remedial alternatives were evaluated for the Petroleum Products Corporation Superfund Site in Pembroke Park, Broward County, Florida. The contamination was the result of uncontrolled disposal of waste oil re-refining sludges in disposal pits below the groundwater table in the vicinity of two municipal well fields. A high level of contamination of soil and groundwater with a variety of compounds was found. Lead, chromium and petroleum hydrocarbons predominanted. Lead concentrations in soils ranged from 5 to 20,700 mg/kg. Total petroleum hydrocarbon concentrations ranged from 40 to 140,000 mg/kg. Approximately 110,000 cu yd of contaminated soil, containing an estimated 450 tons of lead and 3,000 tons of total petroleum hydrocarbons, are subjected to leaching by surface water infiltration and groundwater flow through the soil. Physico-chemical interactions of waste oil sludge compounds with soil and groundwater were evaluated. Contaminated soil was tested for solubility, leachability, soil washing applicability and incineration potential. The tests indicated that due to the waste characteristics and site geohydrological conditions, transport of soluble contaminants off-site would be limited. Five remedial action alternatives, including the no-action alternative, were developed using combinations of remedial technologies such as capping, plume containment by slurry walls, off-site disposal, soil washing, incineration, solidification/fixation and groundwater treatment. General cost estimates for each alternative are provided. At present, there is an indication of salt water intrusion due to the high pumping rate of the municipal well fields and the proximity of this site to Florida's east coast. Treatment of the contaminated soil by the soil washing process and groundwater treatment will bring about a permanent solution to the site contamination problem. (See also W89-12002) (Lantz-PTT)
W89-12039

OIL SPILL REMEDIAL ACTIONS: TWO CASE HISTORIES.
Weston (Roy F.), Inc., Northbrook, IL. SPER Div.
R. M. Bort, D. G. Pyles, H. M. Ricketts, and G. R. Connor.
IN: HWHM 88: Hazardous Wastes and Hazardous Materials. Proceedings of the 5th National Conference held April 19-21, 1988, Las Vegas, Nevada. 1988. p 291-295, 5 fig.

Descriptors: *Water pollution treatment, *Oil spills, *Cleanup operations, *Case studies, Water pollution prevention, Trenches, Skimming, Oil recovery, Groundwater pollution.

Two case histories of remedial activities at oil spill sites are discussed. The first case history is for a surface spill of 12,000 billion barrels (bbl) of crude oil resulting from a punctured 34-in. pressurized oil transmission line. Initial remedial actions taken were to remove oil from surface waters and to excavate and dispose of the oil, saturated surficial soils. In addition, trenches were excavated in an effort to recover product from the unsaturated zone. Subsequently, remedial alternatives were evaluated based on removal effectiveness and cost. The long-term recommended remedial action consisted of a passive French drain collection system and an automatic skimmer unit to remove the collected oil. The recommended system was installed and, after some modifications, effectively prevented product migration. The second case history is for an underground spill of heavy processing oil resulting from the failure of a buried, 2-in. pressurized transfer line at a manufacturing facility in Illinois. The time of failure and volume of oil released are unknown but the release is estimated to have been occurring for a 2-yr. period. The fill in the spill location is approximately 15 to 20 ft thick and consists of silty clay. The leak occurred along the inside wall of the building foundation below the floor slab. Oil contamination spread underneath the building floor, downward within the sand backfill of the transfer pipeline trench and into an intersecting stormwater pipeline trench. Initial remedial actions to recover the oil included excavation of pits within and outside the building adjacent to the source. The initial thickness of oil floating on the water surface in the pits was over 12 in. Recovery from the pits was initiated utilizing oil absorbent fiber mats and buoys. Subsequently, oil recovery technologies were evaluated and the recommended long-term recovery system was an

active system which provides groundwater gradient control and a mechanical skimmer to remove the collected product. The system was installed at the site and has been effective in removing the remaining product. (See also W89-12002) (Author's abstract)
W89-12040

WASTE DISPOSAL IN THE FEDERAL REPUBLIC OF GERMANY.
Bilfinger und Berger Bauaktiengesellschaft, Mannheim (Germany, F.R.).
For primary bibliographic entry see Field 5E.
W89-12041

CLOSING A HAZARDOUS WASTE FACILITY: ENVIRONMENTAL CONCERNS.
Environmental Science and Engineering, Inc., Salt Lake City, UT.
For primary bibliographic entry see Field 5E.
W89-12042

STEEL MILL CLOSURE.
ERT, Inc., Camarillo, CA.
J. E. Skelton.
IN: HWHM 88: Hazardous Wastes and Hazardous Materials. Proceedings of the 5th National Conference held April 19-21, 1988, Las Vegas, Nevada. 1988. p 317-319, 2 fig.

Descriptors: *Site remediation, *Industrial wastes, *Water pollution prevention, *Steel industry, *Waste management, Project planning, Polychlorinated biphenyls, Groundwater pollution, Monitoring, Water pollution control, Containment.

An environmental liability assessment of an operating steel mill was performed to establish potential financial risks under two scenarios: (1) sale as an operating unit, or (2) sale of land only. After this study, the owner decided to close the mill and remediate environmental problems. An in-depth liability assessment included: detailed employee interviews; visual inspection of the site and facilities; investigating suspected subsurface and surface contaminated areas with borings, non-destructive surficial testing methods, test pits and surface sampling; sampling of transformers and capacitors for polychlorinated biphenyl (PCB) oils; sampling building interiors for electric arc furnace dust; determining groundwater quality and flow direction; sampling of surface water and sludge in recirculation ponds; and sampling deep surface water discharge dry wells. Based on the results of this assessment, remediation plans for each area of concern were prepared, remediation contractors were retained and coordinated, decontamination testing was performed and closure certifications were prepared. (See also W89-12002) (Author's abstract)
W89-12043

SITE CHARACTERIZATION AND CLOSURE.
ERT, Inc., Camarillo, CA.
R. M. Coomes, and J. R. McLaughlin.
IN: HWHM 88: Hazardous Wastes and Hazardous Materials. Proceedings of the 5th National Conference held April 19-21, 1988, Las Vegas, Nevada. 1988. p 320-327, 9 fig, 2 tab.

Descriptors: *Arid climates, *Waste disposal, *Waste disposal sites, *Land disposal, *Water pollution prevention, Oil wastes, Hydrocarbons, Containment, Landfills, Groundwater pollution, Monitoring, Permits, Aquifers.

The characterization and closure of an 80-acre site that contained 23 surface impoundment land treatment units is reported. This treatment facility operated as a Class II disposal site for 12 years and accepted more than 15 million barrels of petroleum-related wastes and some Resource Conservation and Recovery Act (RCRA) listed wastes. More than 95% of the wastes accepted at the site resulted from petroleum production operations. One site closure objective was to utilize approximately one half of the 80-acre site for future unrestricted use and to have access to the site perimeter. Viable closure options that permit future site use are: (1) remove all wastes and clean-close the site, or (2) clean-close portions of the site by removing and transferring wastes to the remainder of the site, which would then be closed as a landfill. An important issue in this closure was applying for an exemption from post-closure groundwater monitoring requirements. The site is in a very arid region that receives approximately 6-in. of precipitation per year. The depth to the uppermost aquifer is more than a 650 ft. (See also W89-12002) (Author's abstract)
W89-12044

WETLANDS AND FLOODPLAINS ASSESSMENTS FOR SUPERFUND SITES UNDER SARA.
Jordan (Edward C.) Co., Inc., Wakefield, MA.
For primary bibliographic entry see Field 2H.
W89-12046

UNDERGROUND STORAGE TANK REGULATIONS: STATUS AND DIRECTION,
Environmental Protection Agency, Seattle, WA. Region X.
For primary bibliographic entry see Field 6E.
W89-12048

SITE CLOSURE AND PERPETUAL CARE OF A LOW-LEVEL RADIOACTIVE WASTE DISPOSAL FACILITY IN SEMI-ARID CLIMATE.
For primary bibliographic entry see Field 5E.
W89-12049

MULTIPATHWAY RISK ASSESSMENT METHODOLOGY COMPATIBLE WITH CALIFORNIA DECISION TREE AND U.S. EPA SUPERFUND GUIDELINES.
ENVIRON Corp., Washington, DC.
R. Scofield, R. Powell, M. Conklin, R. Machado, and S. Youngren.
IN: HWHM 88: Hazardous Wastes and Hazardous Materials. Proceedings of the 5th National Conference held April 19-21, 1988, Las Vegas, Nevada. 1988. p 368-372, 7 tab, 6 ref.

Descriptors: *Path of pollutants, *Risk assessment, *Superfund, *Project planning, *California, Drinking water, Regulations, Fate of pollutants, Model studies, Toxicity, Public health.

A risk assessment methodology applicable to the wide variety of site and waste characteristics found at town gas sites and compatible with the regulatory environment in which remediation decisions will be made is presented. The methodology is designed to estimate risks by multiple pathways, to provide upper-bound estimates of risks and to be compatible with a tiered approach to site investigation. Simple fate and transport models combined with simple exposure models are used to estimate exposures via inhalation of volatile emissions, inhalation of windblown dust, ingestion of drinking water, ingestion of soil and dermal contact with soil. Other pathways can be added if warranted by site-specific considerations. Individual pathway exposure estimates combined with carcinogenic and non-carcinogenic toxicity data are used to estimate health risks attributable to each exposure pathway and are combined to estimate the risks presented by the site as a whole. In addition, risk-based target concentrations for drinking water and air are estimated; the methodology could be used to estimate site-specific target concentrations for soil. The need for remediation at a site can then be evaluated by comparing measured or predicted ambient concentrations to target concentrations for each medium and by evaluating the risk presented by exposure to waste constituents in all media. The multi-pathway risk estimates enable the analyst to identify a specific pathway(s) requiring control. (See also W89-12002) (Lantz-PTT)
W89-12051

QUANTITATIVE RISK ASSESSMENT AS THE BASIS FOR THE SELECTION OF REMEDIAL ACTIONS.
NUS Corp., Pittsburgh, PA.
J. M. Patarcity, J. C. Johnson, and E. J. Finnerty.
IN: HWHM 88: Hazardous Wastes and Hazardous Materials. Proceedings of the 5th National Conference held April 19-21, 1988, Las Vegas, Nevada. 1988. p 373-377, 4 fig, 2 tab, 6 ref.

Descriptors: *Risk assessment, *Waste disposal sites, *Feasibility studies, *Cleanup operations, *Water pollution prevention, Path of pollutants, Hazardous wastes, Water pollution treatment, Groundwater pollution, Site remediation.

The objectives of a feasibility study (FS) for a hazardous waste site is to develop and evaluate remedial action alternatives that mitigate public health and environmental concerns. The remedy selected must adequately protect the public health and environment both during and after remediation. Quantitative risk assessment provides a means to both develop and evaluate remedial action alternatives to meet these goals. For the Caldwell Trucking Company Site in Fairfield County, New Jersey, risk assessment techniques were used to: identify contaminant transport routes and exposure pathways that required remediation; define remedial objectives and cleanup criteria; identify general response actions for each exposure pathway and migration route of concern; and develop and evaluate remedial technologies and alternatives. Despite both on-site and off-site multimedia environmental contamination and multiple routes of contaminant migration at the site, risk assessment provided a means to focus remedial actions on source areas and migration routes that posed unacceptable risks to receptors. The result was the selection of a remedial action that addresses all public health and environmental concerns. (See also W89-12002) (Lantz-PTT)
W89-12052

GROUNDWATER QUALITY MONITORING IN A RISK ASSESSMENT FRAMEWORK.
Environmental Monitoring and Support Lab., Las Vegas, NV.
For primary bibliographic entry see Field 5A.
W89-12057

CATALYTIC OXIDATION AND CARBON ADSORPTION FOR VOC EMISSIONS FROM AIR STRIPPERS.
Air Force Engineering and Services Center, Tyndall AFB, FL.
F. T. Lubozynski, R. A. Ashworth, and R. W. Coutant.
IN: HWHM 88: Hazardous Wastes and Hazardous Materials. Proceedings of the 5th National Conference held April 19-21, 1988, Las Vegas, Nevada. 1988. p 445-450, 9 fig, 6 tab, 8 ref.

Descriptors: *Air stripping, *Volatilization, *Activated carbon, *Adsorption, *Water pollution treatment, *Volatile organic compounds, Organic compounds, Air pollution, Groundwater pollution, Temperature, Ozone.

Packed column air stripping is a cost-effective and efficient method to remove volatile organic compounds (VOCs) from groundwater, but it has been criticized by numerous environmental regulatory agencies because of potential air pollution. Catalytic oxidation has been commonly used in industrial operations to control non-chlorinated compounds. Before the technique could be applied to groundwater air stripping operations, performance data were needed on gas streams containing chlorinated organic mixtures at relatively low concentrations ($<$ 200 parts per million (ppm)). The effectiveness of two commercially available pilot-scale catalytic oxidizers was evaluated. The test vapor streams consisted of low concentrations (3 to 200 ppm) of mixtures which represented emissions from air strippers used to treat contaminated groundwater at US Air Force bases. One system employed a metal oxide catalyst in a fluidized-bed configuration. Destruction efficiencies were between 97% and 99% at a catalyst temperature of 950 F. The other system used a fixed-bed proprietary catalyst, supplemented with UV light and ozone injection. Destruction efficiencies for the UV-ozone-catalytic oxidizer ranged from 16-67% without ozone addition. Activated carbon has been used for air emissions control; however, little is known about the

effects of high humidity and competition for adsorption between various organic chemicals and water vapor. Ten commercially available carbon sorbents were evaluated for ability to adsorb selected VOCs. The most promising of these sorbents were subjected to detailed adsorption testing at different temperature, flow rates, sorbate compositions and relative humidity. Results of the current work indicate that significant improvement in retention of VOCs, especially for the more volatile VOCs, can be obtained by reducing the effective relative humidity to below 40-50%. One way t accomplish the increase in humidity is to increase the bed temperature. Although increased temperature decreases the capacity of the carbon for VOCs, the reduction in water capacity is faster. Therefore, the net result is a gain in VOC capacity relative to the humid system. (See also W89-12002) (Lantz-PTT)
W89-12063

ENHANCED VOLATILIZATION FOR REMOVAL OF HAZARDOUS WASTE FROM SOIL.
Midwest Water Resource, Inc., Charlotte, MI.
F. C. Payne, and J. B. Lisiecki.
IN: HWHM 88: Hazardous Wastes and Hazardous Materials. Proceedings of the 5th National Conference held April 19-21, 1988, Las Vegas, Nevada. 1988. p 456-458, 4 fig.

Descriptors: *Water pollution prevention, *Volatilization, *Soil contamination, *Hazardous wastes, *Cleanup operations, *Vadose zone, Groundwater pollution, Evaporation, Organic compounds, Chlorinated hydrocarbons, Aromatic compounds, Benzene, Toluene, Xylenes, Groundwater quality, Vapor pressure.

Soils in the unsaturated (vadose) zone are frequently found to be reservoirs of groundwater contaminant materials at hazardous waste sites. Many of the contaminants at these sites have vapor pressure levels at soil temperatures which allow their removal by enhanced volatilization (EV) procedures. EV processes generally remove solvent-laden air from soils, depending upon evaporation of the target materials to drive the process. Enhanced volatilization removal of many hazardous waste compounds has been conducted, including chlorinated solvents, aromatic ring compounds (benzene, toluene, xylenes, ethylbenzene) and other cyclic and noncyclic carbon compounds (e.g., ketones, naptha, mineral spirits and lacquer diluter). Experience indicates that removal of soil volatiles to levels which yield an aqueous phase equilibrium concentration at or below Federal drinking water standards is a realistic treatment objective. Test data show that these levels can be reached within 3 to 6 months for most sites at costs roughly 10% to 30% of excavation and landfilling. Applicability of EV to a specific area is determined by pneumatic conductivity of soils, vapor pressure of target compounds at soil temperature and off-gas control capability. (See also W89-12002) (Author's abstract)
W89-12064

COST EFFECTIVE INVESTIGATION AND REMEDIATION OF VOLATILE-ORGANIC CONTAMINATED SITES.
Mathes (John) and Associates, Inc., Columbia, IL.
D. E. Markley.
IN: HWHM 88: Hazardous Wastes and Hazardous Materials. Proceedings of the 5th National Conference held April 19-21, 1988, Las Vegas, Nevada. 1988. p 463-466, 6 fig, 1 tab, 3 ref.

Descriptors: *Water pollution treatment, *Water pollution prevention, *Cost-benefit analysis, *Cleanup operations, *Volatile organic compounds, Soil contamination, Costs, Economic aspects, Groundwater pollution, Ventilation, Site remediation.

The use of soil gas sampling and analysis as part of site investigations for volatile organic compounds (VOCs) is presented. The methods and costs for collecting soil gas samples are compared to the collection of soil samples by borehole drilling and the collection of groundwater samples by monitoring well installation. The data show that the use of soil gas surveys can assist in reducing site investigation costs. At one site, a total of 733 pounds of VOCs have been removed by soil venting over a period of 4 months. The operational costs of VOC removal by soil venting at the same site was approximately $9/lb. The operational cost for contaminant removal at the same site using a combination of venting of the vadose zone and bioreclamation of the saturated zone was projected over the duration of remediation to $11 to $15/lb. The cost to remove VOCs using soil venting is approximately 10-20% of the cost of VOC removal using in situ removal by bioreclamation. (See also W89-12002) (Lantz-PTT)
W89-12066

DEVELOPMENT AND EFFECT OF LEAK DETECTION REGULATIONS.
PEI Associates, Inc., Englewood, CO.
C. Kussel.
IN: HWHM 88: Hazardous Wastes and Hazardous Materials. Proceedings of the 5th National Conference held April 19-21, 1988, Las Vegas, Nevada. 1988. p 494-496, 1 fig, 2 ref.

Descriptors: *Regulations, *Leakage, *Landfills, *Water pollution prevention, Monitoring, Waste disposal, Design standards, Liners, Land disposal, Evaluation.

Leak detection regulations affecting new and some existing hazardous waste landfills, surface impoundments, waste piles and land treatment units were proposed by the EPA on May 29, 1987. The proposed rule was issued under the authority of Sections 3004(a) and 3004(o) of Resource Conservation and Recovery Act (RCRA). These regulations include additional design, performance, monitoring and reporting requirements to those previously required of owners and operators. Specifically, the regulations include additional design and performance standards for the leachate collection and removal system (LCRS) between the top and bottom liners, which will serve as the leak detection system; a chosen action leakage rate (ALR) for leakage from the top liner (site-specific or EPA chosen); and a response action plan (RAP) to be implemented if the ALR is exceeded. The land treatment leak detection regulations require additional provisions for treatment zone monitoring. Once an ALR value is exceeded, the owner will be required to notify the EPA and implement a response action. As long as the response action is being implemented, the determination of its effectiveness as well as the need to implement a new response will be a continual interactive process with the EPA. The proposed regulations are expected to impact approximately 128 landfills, 535 surface impoundments, 72 waste piles and 71 land treatment facilities. The leak detection regulations will be finalized by EPA later this year. The actual impact of these regulations will depend on the values EPA chooses for system design and performance specifications and the ALR. (See also W89-12202) (Author's abstract)
W89-12069

RECOVERY OF DNAPL--THEORY AND PRACTICE.
Union Carbide Corp., South Charleston, WV.
B. E. Smith, and J. F. Sykes.
IN: HWHM 88: Hazardous Wastes and Hazardous Materials. Proceedings of the 5th National Conference held April 19-21, 1988, Las Vegas, Nevada. 1988. p 497-500, 4 fig, 5 ref.

Descriptors: *Water pollution treatment, *Cleanup operations, *Waste recovery, *Groundwater pollution, *Path of pollutants, Fluid mechanics, Aquifers, Wells, Theoretical analysis, Site remediation.

A study was made to investigate the theory of migration of dense non-aqueous phase liquids (DNAPL) or non-floating materials in groundwater, then to conduct pilot recovery well tests to demonstrate the practicality of remediation of DNAPL contaminated aquifers via recovery well technology. The theoretical study involved an extensive literature review and reassessment of the equations of flow for immiscible fluids. The field study involved the performance of pumping tests at two wells known to be contaminated with DNAPL. A summary of the detailed investigation is presented. DNAPL can occur in three types of fluid saturation: pendular, funicular and insular. Flow of DNAPL as the non-wetting fluid can occur in the funicular saturation phase. Pendular and insular phase saturation typically will remain immobile unless the degree of saturation or pressure difference is significantly changed. Theoretically, a recovery well may be a feasible method to remove a portion of the mobile DNAPL, although a residual quantity will remain in the aquifer matrix interstices. In pumping pure DNAPL at a given rate, the pressure decrease will be approximately proportional to the viscosity. Therefore, higher viscosity DNAPL will have an increased drawdown compared to water. For the same total drawdown, less DNAPL will be pumped than in a comparative water system. Pilot production wells were pumped at two sites (Texas and Puerto Rico) from DNAPL contaminated, fine-grained aquifers. DNAPL occurred in the sediments at both sites in discontinuous zones with varying degrees of saturation. DNAPL was removed in both wells at approximately 1% of the discharge volume. The wells were pumped at about 1 gal/min for 10 hours at one site and about 2 months at the other. The pumping tests indicate that mobile DNAPL can be removed from the aquifer matrix via recovery wells. (See also W89-12202) (Author's abstract)
W89-12070

COUNTY SPECIFIC HAZARDOUS WASTE MANAGEMENT PLANS.
Brown, Vence and Associates, San Francisco, CA.
J. P. Cummings, and M. D. Brown.
IN: HWHM 88: Hazardous Wastes and Hazardous Materials. Proceedings of the 5th National Conference held April 19-21, 1988, Las Vegas, Nevada. 1988. p 522-527, 3 tab, 10 ref.

Descriptors: *Water pollution prevention, *Hazardous wastes, *Waste management, *Management planning, *Waste disposal, *California, *Legislation, Local governments, Site selection, Toxicity, Water treatment.

The California Legislature has passed the 'Tanner Bill' AB2948 in order to reduce and cope with increasing hazardous waste generation. Planning for source reduction, minimization and residual deposition requires knowledge of what wastes are currently generated, growth parameters and reduction processes for waste management generation. The plans for hazardous waste management require safe, effective and economical approaches to protect public health and the environment. Assessment technologies are discussed for a county which typifies the program, and itemizes assessment techniques for large hazardous waste generators, small quantity generators and household generators of various hazardous materials. Feasible approaches are presented for eliminating generation of waste by changing manufacturing or chemical processes and, in some cases, on-site treatment to reduce the hazardous or toxic effects of the waste stream. In situations where on-site treatment or reduction is impractical, then suggested off-site treatment and residual repository programs are developed. The selection process for these sites, the logistical aspects and safe transportation of hazardous wastes and ancillary systems such as transfer stations were shown. Programs for reduction of hazardous waste by small quantity generators and household hazardous wastes are also addressed. (See also W89-12002) (Author's abstract)
W89-12071

MUNICIPAL HAZARDOUS MATERIALS MANAGEMENT PROGRAMS IN CALIFORNIA.
PRC Environmental Management, Inc., San Francisco, CA.
For primary bibliographic entry see Field 5E.
W89-12072

CORRECTIVE ACTION AT SOLID WASTE MANAGEMENT UNITS UNDER A RCRA

PERMIT; AN AUTHORIZED STATE'S EXPERIENCE.
Georgia Environmental Protection, Atlanta.
For primary bibliographic entry see Field 5E.
W89-12073

TREATABILITY STUDIES FOR WATERS IN THE OIL POND NO. 1, OIL POND NO. 2, AND THE OIL SEEP.
Oak Ridge National Lab., TN.
J. M. Napier, C. W. Hancher, G. E. Harris, M. E. Johnson, and B. C. Padgett.
Available from the National Technical Information Service, Springfield, VA 22161, as DE88-011587. Price codes: A03 in paper copy, A01 in microfiche. Report No. Y/DZ--392, May 3, 1988. 36p, 1 fig, 16 tab. DOE Contract DE-AC05-84OR21400.

Descriptors: *Oak Ridge National Laboratory, *Leakage, *Water pollution treatment, *Cleanup operations, *Underground waste disposal, *Oil wastes, Wastewater treatment, Pilot plants, Polychlorinated biphenyls, Filtration, Carbon filters, Air stripping, Metals, Permits, Seepage, Water quality, Organic carbon.

Laboratory and pilot plant studies have investigated treatment methods for water contained in 2 small ponds located at the Bear Creek burial grounds. These ponds were originally installed to serve as unlined collection basins for leakages of oily wastes from old burial trenches used for disposal of wastes from the Y-12 plant. The sediments in the bottom of the pond are contaminated with polychlorinated biphenyls (PCB) and plans to close out these ponds and remove the sediments have been prepared. These laboratory and pilot plant studies show that the water in the ponds contained no significant amounts of metals and only trace quantities of organics. The amount of PCB in the water was near the detection level. The biological quality of the water before treatment was excellent. Unit operations examined in these studies included filtration, air stripping and carbon filtration. Air stripping removed all of the trace amounts of volatile organics and carbon filtration removed all of the detectable quantities of other organics, except for the low amounts of total organic carbon. Based on these tests it has been recommended that the water in the ponds be filtered and released without additional treatment through a permitted discharge point. Water from any oil seep is recommended to be collected and treated using filtration, air stripping and carbon filtration. Any water released from this process should meet the permitted discharge quality plus meet a biological test specified by the permitting agency. (Author's abstract)
W89-12099

WATER QUALITY OF INTERSTATE STREAMS IN THE SUSQUEHANNA RIVER BASIN MONITORING REPORT 2: WATER YEAR 1988 (OCTOBER 1987-SEPTEMBER 1988).
Susquehanna River Basin Commission, Harrisburg, PA.
For primary bibliographic entry see Field 5B.
W89-12102

PLAN FOR STUDY: RESPONSE OF THE HABITAT AND BIOTA OF THE INNER NEW YORK BIGHT TO ABATEMENT OF SEWAGE SLUDGE DUMPING.
National Marine Fisheries Service, Woods Hole, MA. Northeast Fisheries Center.
Available from the National Technical Information Service, Springfield, VA 22161, as PB89-100903. Price codes: A03 in paper copy, A01 in microfiche. NOAA Technical Memorandum NMFS-F/NEC-55, June 1988. 34p, 2 tab, 11 ref, 3 append.

Descriptors: *Ocean dumping, *Sludge disposal, *Water pollution effects, *New York Bight, *Water pollution control, Sludge, Marine environment, Marine fisheries, Benthic fauna, Fish diets, Flounders, Macroinvertebrates, Lobsters, Bacteria, Biochemical oxygen demand.

Sewage sludge has been dumped at a site 12 nautical miles from Sandy Hook in the inner New York Bight since 1924. Between March 1986 and December 1987, disposal of sludge is scheduled to be moved to Deepwater Dumpsite 106. The purpose of this study is to document changes in living marine resources and their habitats during and following the period in which sewage sludge dumping is phased out at the 12-mile site. Choice of monitoring variables is based on two considerations: (1) relevance to fisheries of the inner Bight in terms of abundance, distribution and contamination of resource species, and as indicated by quality of their habitats, and (2) predictive value in detecting changes after abatement. Ideally, replicate measurements of a complete suite of variables should be collected at all sample locations. However, replicated sampling is costly and labor intensive. Hence, the overall survey design is a compromise consisting of two complementary sampling surveys which are termed 'replicate' and 'broadscale'. Biotic variables to be measured during the study are: distribution and abundance of fish and invertebrates; diets of winter flounder, red hake, silver hake, and lobster; organic contaminants in selected species; migration of winter flounder; gross pathology; benthic fauna; and bacteria in sediments and tissues. Habitat variables to be studied are: water chemistry, sediment chemistry, seabed and bottom-water metabolism, and pathways and rates of sludge and contaminant dispersion. The working hypotheses by which post-dumping recovery will be assessed include: (1) that finfish and invertebrate communities will differ significantly among the three replicate sites prior to cessation of dumping; (2) that eventually, following cessation of dumping, abundance and distribution of finfish and invertebrates at the most polluted sites will be similar to the relatively cleaner; (3) that the diet of winter flounder, lobster and other species will change during the period in which dumping is phased out; (4) that the number of crustacean forage organisms at the dumping site will increase significantly; (5) that the intensity of perennial hypoxia will be relieved throughout most of the Basin; and (6) that with the cessation of sewage sludge dumping the seabed oxygen consumption rates in the dumpsite will be reduced from the present high rates to more natural rates, and that the associated benthic nutrient regeneration rates will decline comparably. (Lantz-PTT)
W89-12111

AGRICULTURE AND WATER QUALITY.
Economic Research Service, Washington, DC. Resources and Technology Div.
B. M. Crowder, M. O. Ribaudo, and C. E. Young.
Available from the National Technical Information Service, Springfield, VA 22161, as PB89-104327. Price codes: A02 in paper copy, A01 in microfiche. Agriculture Information Bulletin Number 548, August 1988. 6p.

Descriptors: *Water quality management, *Agriculture, *Water quality control, *Agricultural runoff, Economic aspects, Farm management, Regulations, Land use.

Agriculture generates byproducts that may contribute to the contamination of America's water supply. Any effective regulations to ban or restrict agricultural chemical or land use practices in order to improve water quality will affect the farm economy. Some farmers will benefit; some will not. Most agricultural pollutants reach surface waterways in runoff; some leach through soil into groundwater. Because surface water systems and groundwater systems are interrelated, farm management practices need to focus on water quality in both systems. Modifying farm management practices may raise production costs in some areas. Farmers can reduce runoff losses by reducing input use, implementing soil conservation practices, and changing land use. Also at issue is who should pay for improving water quality; farmers, governments, consumers, or those who benefit from improved water quality. (Author's abstract)
W89-12112

UNDERGROUND COAL GASIFICATION CONTAMINANT CONTROL PROGRAM: SIMULATION OF POSTBURN UCG CONTAMINANT PRODUCTION.
University of Wyoming Research Corp., Laramie. Western Research Inst.
For primary bibliographic entry see Field 5B.
W89-12114

ENVIRONMENTAL POLLUTION CONTROL ALTERNATIVES: SLUDGE HANDLING, DEWATERING, AND DISPOSAL ALTERNATIVES FOR THE METAL FINISHING INDUSTRY.
Centec Corp., Reston, VA.
For primary bibliographic entry see Field 5E.
W89-12127

PROTECTION OF PUBLIC WATER SUPPLIES FROM GROUND-WATER CONTAMINATION.
Environmental Protection Agency, Cincinnati, OH. Center for Environmental Research Information.
L. L. Graham, R. C. Heath, L. Hinkle, O. T. Love, and J. F. McNabb.
Center for Environment Research Information Technology Transfer Report EPA/625/4-85/016, September 1985. 182p, 184 fig, 26 tab, 129 ref. EPA Contract 68-03-3130.

Descriptors: *Groundwater pollution, *Water quality control, *Water pollution prevention, *Water supply, Drinking water, Groundwater quality, State jurisdiction, Federal jurisdiction, Local governments, Water supply development, Safe Drinking Water Act, Water quality standards, Decontamination, Public health, Waste disposal, Land use, Aquifer management, Surface-groundwater relations.

The problem of groundwater protection is addressed in chapters discussing basic groundwater hydrology, classification of groundwater regions, groundwater-surface water relationships, groundwater pollution, management alternatives, and controlling volatile organic compounds in groundwater used for drinking. The development of subsurface water supplies has little effect on land use and can usually be accomplished at relatively low cost compared to the development of surface supplies. However, the subsurface environment is a complex system subject to contamination from a host of sources. The extremely slow movement of pollutants through this environment results in a longer residence time and little diffusion of many pollutants. Because of the protracted effects of contamination and problems of accessibility, the restoration of groundwater quality is difficult and expensive. It is widely agreed that the most viable approach to groundwater quality protection is one of prevention rather than cure. At the Federal level, the Safe Drinking Water Act, in particular, adds to the protection of groundwater. In addition to establishing minimum drinking water standards, regardless of the source, it addresses the protection of groundwater quality and provides for research, technical assistance, and personnel training. Protection of groundwater quality at the state level is gained from source control and from statutes dealing with surface water, which generally are based on public health concepts. Land use regulations also are used to protect groundwater quality by locating waste sources, such as lagoons and solid waste facilities, in selected areas in order to minimize the pollution potential. While statutory authority exists to regulate most contamination sources there is a need for additional controls at the local level. Suitable aquifer protection controls can be adopted under local planning and zoning laws which take into account land use, industrial development, health, housing and agriculture. (Lantz-PTT)
W89-12128

PESTICIDE APPLICATORS SAFETY MANUAL FOR IRRIGATION SYSTEMS.
Bureau of Reclamation, Denver, CO. Div. of Research and Lab. Services.
Available from the National Technical Information Service, Springfield, VA 22161 as PB89-120471, Price codes: A07 in paper copy, A01 in microfiche. Bureau of Reclamation, 1988. 131p, 12 fig, 4 tab, 39 ref, 2 append.

Descriptors: *Safety, *Handbooks, *Pesticides, *Water pollution prevention, *Irrigation, Public health, Water quality control, Education, Training.

This manual provides safety guidelines for pesticide handling, storage, and application. It is intended to be a practical, convenient, and comprehensive reference for instructing personnel in the safe use of pesticides on projects. It stresses protecting people by providing basic information for compliance with safety and health standards established by the U.S. Occupational Safety and Health Administration and U.S. Environmental Protection Agency. It is designed to be a ready reference during the planning phase of pesticide application projects, particularly when job hazards are analyzed and safety precautions are determined. (Author's abstract)
W89-12129

LINERS FOR WASTE DISPOSAL AND WASTE STORAGE FACILITIES, JANUARY 1976-APRIL, 1988: CITATIONS FROM THE ENERGY DATA BASE.
National Technical Information Service, Springfield, VA.
For primary bibliographic entry see Field 5E.
W89-12142

NUTRIENT REMOVAL FROM LAKES, PONDS, AND RIVERS, JANUARY 1977-JUNE 1988: CITATIONS FROM THE SELECTED WATER RESOURCES ABSTRACTS DATABASE.
National Technical Information Service, Springfield, VA.
Available from National Technical Information Service, Springfield, VA 22161 as PB88-865548, Price codes: N01 in paper copy, N01 in microfiche. June 1988. 45p. Supersedes PB85-863231.

Descriptors: *Water pollution treatment, *Nutrient removal, *Bibliographies, *Water quality control, Wastewater management, Lakes, Rivers, Streams, Ponds, Biological treatment, Reservoirs, Phosphorus removal, Cycling nutrients.

This bibliography contains citations concerning nutrient removal techniques in lakes, ponds, rivers and streams relative to water quality control and waste water management. Natural and artificial removal processes such as removal by biological treatment, sedimentation, reservoir and flooded field are discussed. This updated bibliography contains 108 citations of which 16 are new entries to the previous edition. (Author's abstract)
W89-12151

LEACHATE TREATMENT, JANUARY 1972-MARCH 1988: CITATIONS FROM THE POLLUTION ABSTRACTS DATABASE.
National Technical Information Service, Springfield, VA.
Available from National Technical Information Service, Springfield, VA 22161 as PB88-860622, Price codes: N01 in paper copy, N01 in microfiche. March 1988. 32p. Supersedes PB87-855078.

Descriptors: *Water pollution prevention, *Leachates, *Bibliographies, *Landfills, Activated sludge, Lagoons, Ultrafiltration, Solvent extraction, Mine wastes, Chemical wastes, Industrial wastes.

This bibliography contains citations concerning a variety of methods utilized in the treatment of leachates. Solvent extraction, lagooning, ultrafiltration, and activated sludge are among the techniques considered. Leachate from landfills, coal piles, and chemical wastes is discussed. This updated bibliography contains 116 citations of which 19 are new entries to the previous edition. (Author's abstract)
W89-12153

BIODETERIORATION OF OIL SPILLS, JANUARY 1970-JANUARY 1988: CITATIONS FROM THE NTIS BIBLIOGRAPHIC DATABASE.
National Technical Information Service, Springfield, VA.
Available from National Technical Information Service, Springfield, VA 22161 as PB88-857594, Price codes: N01 in paper copy, N01 in microfiche. February 1988. 58p. Supersedes PB82-807371.

Descriptors: *Oil pollution, *Biodegradation, *Bibliographies, *Water pollution treatment, Oil spills, Cleanup operations, Petroleum products, Microbial degradation, Cold regions, Beaches, Surface water, Underwater, Hydrocarbons.

This bibliography contains citations concerning the degradation of petroleum products, including hydrocarbons, oil spills, and beach pollution. Microbial degradation of petroleum products on land, on the surface of the water, and underwater are discussed. Composting techniques and genetic engineering to facilitate oil degradation are briefly cited. The effect of cold climates on degradation speeds is studied. This updated bibliography contains 173 citations of which 31 are new entries to the previous edition. (Author's abstract)
W89-12171

6. WATER RESOURCES PLANNING

6A. Techniques Of Planning

OPTIMAL SEQUENCING OF DEVELOPMENT FOR HYDROPOWER STATIONS IN CASCADE.
Wuhan Inst. of Hydraulic and Electric Power Engineering (China).
For primary bibliographic entry see Field 8C.
W89-11603

PROCESS FOR COOPERATION ON INTERNATIONAL RIVER BASIN PROJECTS.
Ministry of Environment and Water Management, Budapest (Hungary).
For primary bibliographic entry see Field 6E.
W89-11723

MULTIDISCIPLINARY PLANNING AND MANAGING OF WATER REUSE.
King Abdulaziz Univ., Jeddah (Saudi Arabia). Dept. of Civil Engineering.
For primary bibliographic entry see Field 5F.
W89-11806

CANADIAN CONFERENCE ON MARINE ENVIRONMENTAL QUALITY: PROCEEDINGS.
For primary bibliographic entry see Field 5G.
W89-11852

SOCIAL, ECONOMIC, INSTITUTIONAL AND LEGAL CONSIDERATIONS IN THE MANAGEMENT OF LAND-BASED SOURCES OF MARINE POLLUTION.
Dalhousie Univ., Halifax (Nova Scotia). Marine Affairs Program.
For primary bibliographic entry see Field 5G.
W89-11856

STRATEGIES FOR THE CONTROL OF LAND-BASED SOURCES OF MARINE POLLUTION IN THE UNITED STATES.
Office of Technology Assessment, Washington, DC.
For primary bibliographic entry see Field 5G.
W89-11859

BOSTON HARBOUR: PAST PROBLEMS AND FUTURE SOLUTIONS.
Environmental Protection Agency, Boston, MA. Region I.
For primary bibliographic entry see Field 5E.
W89-11860

MARINE ENVIRONMENTAL QUALITY MANAGEMENT IN BRITISH COLUMBIA.
Ministry of Environment and Parks, Victoria (British Columbia). PLanning and Assessment Branch.
For primary bibliographic entry see Field 5G.
W89-11861

PUGET SOUND: THE CHALLENGE OF IMPLEMENTING AN ESTUARY PROTECTION PLAN.
Puget Sound Water Quality Authority, Seattle, WA.
For primary bibliographic entry see Field 5G.
W89-11862

MARINE ENVIRONMENTAL QUALITY IN CANADA: STATUS AND ISSUES, THE PACIFIC COAST OF CANADA.
Ministry of Environment and Parks, Victoria (British Columbia). PLanning and Assessment Branch.
For primary bibliographic entry see Field 5G.
W89-11864

MARINE ENVIRONMENTAL QUALITY IN CANADA: BUILDING CONSTITUENCIES.
International Inst. for Transportation and Ocean Policy Studies, Halifax (Nova Scotia).
For primary bibliographic entry see Field 5G.
W89-11867

AGRICULTURAL CHEMICALS IN GROUND WATER: PROPOSED PESTICIDE STRATEGY.
Environmental Protection Agency, Washington, DC. Office of Pesticides and Toxic Substances.
For primary bibliographic entry see Field 5G.
W89-11881

ENVIRONMENTAL EVALUATION OF POTENTIAL PETROLEUM DEVELOPMENT ON THE NATIONAL PETROLEUM RESERVE IN ALASKA.
For primary bibliographic entry see Field 4C.
W89-11897

PREVENTION AND CONTROL OF OIL AND HAZARDOUS-MATERIAL SPILLS.
Texas A and M Univ., College Station. Dept. of Civil Engineering.
For primary bibliographic entry see Field 5G.
W89-11901

SUFFOLK COUNTY WATER AUTHORITY WATERSHED PROTECTION STRATEGY.
Suffolk County Water Authority, Oakdale, NY.
S. J. Meyland, and R. Lamonica.
IN: Proceedings of the FOCUS Conference on Eastern Regional Ground Water Issues, September 27-29, 1988, Stamford, Connecticut. National Water Well Association, Dublin, Ohio, 1988. p 463-467.

Descriptors: *Public utility districts, *Groundwater management, *Management planning, *Suffolk County, *Water pollution control, Groundwater budget, Regulations, Information systems, Public participation, Education, Groundwater protection, Wells, Geohydrology.

Suffolk County is underlain by glacial and Cretaceous age coastal plain aquifers having enormous water supply potential. However, the same factors that make this aquifer system so productive, also make it extremely vulnerable to contamination from a vast array of activities. Septic system discharges, agricultural chemicals and fertilizers, industrial waste disposal, solid waste landfill, gasoline spills and salt water intrusion, all contribute contaminants to what was once a pristine aquifer. Starting in June 1987, the Suffolk County Water Authority (SCWA) embarked on the development of a Watershed Protection Project which would permit the authority to play a more active and effective role in water resource management. The project is nearing completing and the major features of the strategy are now defined, and include: (1) a Watershed Protection Committee (WPC) was organized; (2) a conceptual approach was present-

ed as to how to address the regional protection of the aquifer. The Core Watershed Corridor (CWC) was identified--this area represents the heart of the deep recharge zone on either side of the groundwater divide; (3) a consulting firm was hired to help map, on a town-by-town basis, the major pollution problems that could be readily identified, and to help determine the current status of land within the CWC; (4) due to the strong public support for land acquisition, all publicly identified acquisition parcels were mapped in order to determine if they fell within the CWC (There was a 90% match within the CWC.); where the lands were close to the CWC, it was expanded to include them; (5) a ranking matrix was developed to enable evaluation of these and future acquisition sites for their specific values to the SCWA; (6) in February 1988, the Board of Directors approved the allocation of $2 million specifically for watershed acquisition of lands within the CWC; (7) a multi-year land acquisition strategy was outlined; and (8) a chemical source reduction program was developed, targeting industrial/commercial areas inside the CWC. (See also W89-11916) (Lantz-PTT)
W89-11942

CHALLENGES IN CREATING A LOCAL GROUNDWATER PROTECTION PLAN.
Housatonic Valley Association, Cornwall Bridge, CT.
For primary bibliographic entry see Field 4B.
W89-11944

LIMITS TO GROWTH AND SEPTIC TANKS.
Connecticut Univ., Storrs. Dept. of Geology and Geophysics.
For primary bibliographic entry see Field 5E.
W89-11959

ENGINEERING ECONOMICS OF RURAL WATER SUPPLY AND WASTEWATER SYSTEMS. PART I: ELEMENTS OF SYSTEM DESIGN.
Rice Univ., Houston, TX. Dept. of Geology.
M. D. Campbell, and S. N. Goldstein.
IN: Water Pollution Control in Low Density Areas: Proceedings of a Rural Environmental Engineering Conference, September 26-28, 1973, Warren, Vermont. University Press of New England, Hanover, New Hampshire, 1975. p 145-157, 3 fig, 16 ref.

Descriptors: *Management planning, *Wastewater treatment, *Economic aspects, *Rural areas, Costs, Public participation, Water treatment facilities, Wells, Maintenance.

Millions of Americans, especially in remote, economically depressed regions, e.g. 'Appalachia' and rural minority centers, do not have safe drinking water or sanitation facilities. While the national delivery system for rural water and sanitation has reached many rural residents in the past, the increased pollution of water supplies, the need for more complex and expensive facilities, and the general shift of human and financial resources away from rural areas have made this system progressively less satisfactory in recent years. The following are major weaknesses in the present system: (1) policy and priority; (2) financing; (3) development; (4) user support; (5) technology; and (6) operation and maintenance. In order to develop a national commitment to good water and sanitation facilities the responsibilities of the public and private sectors must be determined. Profit-making interests have not been able, however, to extend service to all rural residents. Scattered, low income rural families cannot afford a central distribution or collection system, nor even individual facilities constructed by private contractors. What seems to be required is some form of public subsidy for the construction and operation of facilities. This kind of public assistance is now so common that it is no longer considered a public subsidy. Although financing by the Farmers Home Administration has significantly advanced the quantity and quality of rural water facilities, it is not unfair to point out that their eligibility requirements for individual loan programs have kept funds from reaching the rural poor. There are four generally accepted system types or alternatives for obtaining a community water supply in rural areas: (1) treatment of raw surface water; (2) purchase of treated surface or groundwater; (3) construction of a single high capacity well system; and (4) construction of multiple or 'cluster' well system. Whether one or a combination of these systems is utilized in an area is dependent upon many factors, not just finances. Regional wells, operation and maintenance, costs, and public participation are just some of these factors. (See also W89-11953) (Lantz-PTT)
W89-11966

ENGINEERING ECONOMICS OF RURAL WATER SUPPLY AND WASTEWATER SYSTEMS. PART II: APPLICATION OF ECONOMIC CRITERIA TO THE EVALUATION OF PROJECT FEASIBILITY (A CASE STUDY).
Rice Univ., Houston, TX. Dept. of Geology.
For primary bibliographic entry see Field 5D.
W89-11967

RURAL WATER SUPPLY: HOW BAD A PROBLEM.
Environmental Protection Agency, Washington, DC.
For primary bibliographic entry see Field 5F.
W89-11969

WATER QUALITY MANAGEMENT PLAN NORTH SEA: FRAMEWORK FOR ANALYSIS.
Waterloopkundig Lab. te Delft (Netherlands).
For primary bibliographic entry see Field 5G.
W89-11995

MANAGEMENT OF TOXIC MATERIALS IN AN INTERNATIONAL SETTING: A CASE STUDY OF CADMIUM IN THE NORTH SEA.
Waterloopkundig Lab. te Delft (Netherlands).
For primary bibliographic entry see Field 5G.
W89-11996

WASTE MINIMIZATION AUDIT MANUAL FOR THE PRINTED CIRCUIT BOARD INDUSTRY.
PRC Environmental Management, Inc., San Francisco, CA.
For primary bibliographic entry see Field 5D.
W89-12019

AIR FORCE SYSTEMS COMMAND WASTE MINIMIZATION STUDY.
Earth Technology Corp., Alexandria, VA.
For primary bibliographic entry see Field 5D.
W89-12020

EVALUATION OF REMEDIAL ALTERNATIVES FOR AN INACTIVE INDUSTRIAL LANDFILL.
Weston (Roy F.), Inc., West Chester, PA.
For primary bibliographic entry see Field 5G.
W89-12032

SITE INSPECTIONS IN SUPPORT OF SUPERFUND'S REVISED PRE-REMEDIAL PROGRAM.
Ecology and Environment, Inc., Arlington, VA.
J. C. Tuttle, and P. Beam.
IN: HWHM 88: Hazardous Wastes and Hazardous Materials. Proceedings of the 5th National Conference held April 19-21, 1988, Las Vegas, Nevada. 1988. p 273-277, 1 fig, 3 tab, 3 ref.

Descriptors: *Water pollution prevention, *Site remediation, *Superfund, *Cleanup operations, *Project planning, Classification, Planning, Management planning, Hazardous wastes, Waste management.

The site inspection (SI) process under the revised Hazard Ranking System (HRS) will encompass two levels of investigation. First, the Screening SI (SSI)--with most sites, the SII will: (1) collect additional data to prepare more refined preliminary HRS and Reasonable Evaluation Process (REP) scores; (2) establish priorities among sites most likely to quality for the National Priority List (NPL); and (3) identify the most critical data requirement for a listing SI (LSI). The SSI will not have high level data quality objectives (DQOs). Based on the refined preliminary HRS and REP scores, the site will be referred to the appropriate State program, another applicable Federal program, or to the LSI level. Second, the Listing Sites (LSI)--sites most likely to qualify for the NPL will be candidates for an LSI. The objectives of an LSI are to: (1) collect comprehensive data to score a site under the revised HRS; and (2) provide adequate documentation for site nominations to the NPL. In addition to satisfying the enhanced data collection requirements of the revised HRS, the LSI will provide remedial investigation (RI) scoping support. It is anticipated that LSIs will help satisfy the EPA's goal to limit RI planning to 3 months and the overall remedial investigation feasibility study (RI/FS) process to 18 months. AN LSI will have high level DQOs necessary to satisfy the documentation requirements of a formal HRS package (i.e., produce litigation-quality data). The two-level SI process is intended to ensure that limited resources are applied only to the highest priority sites bound for the NPL. (See also W89-12002) (Author's abstract)
W89-12038

STEEL MILL CLOSURE.
ERT, Inc., Camarillo, CA.
For primary bibliographic entry see Field 5G.
W89-12043

WETLANDS AND FLOODPLAINS ASSESSMENTS FOR SUPERFUND SITES UNDER SARA.
Jordan (Edward C.) Co., Inc., Wakefield, MA.
For primary bibliographic entry see Field 2H.
W89-12046

SITE CLOSURE AND PERPETUAL CARE OF A LOW-LEVEL RADIOACTIVE WASTE DISPOSAL FACILITY IN SEMI-ARID CLIMATE.
For primary bibliographic entry see Field 5E.
W89-12049

STATE REGULATORY APPROACHES TO MANAGEMENT OF MINING WASTES.
CDM Federal Programs Corp., Fairfax, VA.
For primary bibliographic entry see Field 6E.
W89-12050

MULTIPATHWAY RISK ASSESSMENT METHODOLOGY COMPATIBLE WITH CALIFORNIA DECISION TREE AND U.S. EPA SUPERFUND GUIDELINES.
ENVIRON Corp., Washington, DC.
For primary bibliographic entry see Field 5G.
W89-12051

ANALYSIS OF WATER RESOURCE SYSTEMS.
Ceske Vysoke Uceni Technicke v Praze. Faculty of Civil Engineering and Architecture.
L. Votruba, Z. Kos, K. Nachazel, A. Patera, and V. Zeman.
Elsevier, New York. 1988. 454p.

Descriptors: *Systems analysis, *Watershed management, *Water resources development, *Water management, Mathematical studies, Simulation analysis, Mathematical models, Research priorities, Model studies, Computer programs, Systems engineering, Operations research, Queueing theory, Information systems.

Water resource systems research provides a basis for rational water management in large basins. The design and operation of water resource systems are both the most complicated and the most important tasks of water management. This book deals with the basic issues involved in the application of systems sciences to water management. A survey of the systems sciences (the general systems theory, cybernetics, systems engineering, operations re-

search and systems analysis) is presented, as well as the methods for water resource systems analysis and for their evaluation. The mathematical methods used in systems theory have been used as models of optimal programming. Since many practical tasks require the simulation models of water resources systems, apart from their principles and a detailed description, the simulation language for computer programming has been included. Other methods of operations research and their application to water resources systems have been analyzed and evaluated. Some of these are: models of inventory theory, models of queueing theory, graphs, network analysis, and some special methods like the out-of-kilter algorithm, the chance-constrained model combined with the simulation model. One chapter is devoted to information and information systems in water management. The final part of the book deals with prospects for water resource systems development. (Lantz-PTT)
W89-12115

WATER MANAGEMENT OF RESERVOIRS.
Ceske Vysoke Uceni Technicke v Praze. Faculty of Civil Engineering and Architecture.
For primary bibliographic entry see Field 4A.
W89-12116

WATER AND WASTEWATER SYSTEMS ANALYSIS.
University of the Witwatersrand, Johannesburg (South Africa). Water Systems Research Programme.
D. Stephenson.
Elsevier, New York. 1988. 221p.

Descriptors: *Systems analysis, Water treatment, *Wastewater treatment, *Water resources development, *Water management, Groundwater management, Water quality management, Storm water, South Africa, Case studies, Model studies, Artificial recharge, Monitoring, Water quality control, Sewer systems, Computer programs, Water sampling, Water reuse.

A systematic approach to decision-making in water resources planning is presented with particular reference to wastewater re-use. Various methods of system simulation and optimization are applied in a number of case studies. Methods of analysis and numerical methods (Chapter 2 and 4) are described as well as the basis of pollution and water quality (Chapters 1 and 3). The economics of desalination are also discussed (Chapter 7). In arid areas, such as Southern Africa, water is at a premium for mining and industrial development and considerable money is spent on water treatment or use of poor quality water. Careful management and distribution of water resources can in these circumstances save a lot of money. The general theory of optimization subject to quality constraints is presented in Chapter 6. The examples studied range from regional supplies (Chapter 10) to internal recirculation (Chapter 8). Groundwater and artificial recharge are considered (Chapter 9) and stormwater quality (Chapter 5) and sewerage systems (Chapters 11 and 12) are also covered. Computer applications exist throughout and a number of simulation and optimization programs in BASIC are presented. Chapter 13 is on an often ignored subject, the necessity for scientific sampling procedures in monitoring water quality. (Lantz-PTT)
W89-12117

6B. Evaluation Process

REGIONALIZATION IN WATER SUPPLY INDUSTRY: STATUS AND NEEDS.
Colorado State Univ., Fort Collins.
N. S. Grigg.
Journal of Water Resources Planning and Management (ASCE) JWRMD5, Vol. 115, No. 3, p 367-378, May 1989. 49 ref.

Descriptors: *Regional planning, *Water supply, *Water resources management, *Governmental interrelations, Political aspects, Economic aspects, Water rates, Water districts, Water delivery, Water demand, Water distribution, Water policy, Data storage and retrieval.

Regionalization is often recommended to help solve the water supply industry's problems but it has received little sustained policy attention. It offers three potential classes of benefits: economies of scale, extension of service to needy areas, and enhanced water quality. Recent reported trends include: consolidation of systems in growing areas, extension of the influence of strong central water suppliers, mergers of investor-owned utilities, state government initiatives, and voluntary cooperation among utilities. Action at the local level is impeded by political considerations but cooperation or integration can be considered on a case-by-case basis. Action at the state level is needed because federal intervention will not be favorably received and decisive local action is unlikely except in a few major population centers. The state level can serve as facilitator, broker, and regulator to resolve thorny institutional issues. To support such state actions, research is needed to determine the effectiveness of existing legislation and programs. The roles are needed from the federal government are policy leadership and financing of research. Without the federal presence, a vacuum in policy analysis and research occurs. Little is known about industry-wide trends in water rates, since they are not subjected to much regulatory scrutiny, and since the industry lacks centralized financial statistics. Improved data bases could aid in overcoming management problems that stem from the lack of both market incentives and economic regulation. (Author's abstract)
W89-11602

LONG-RANGE FINANCIAL PLANNING FOR WATER UTILITIES.
Tucson Water Dept., AZ.
For primary bibliographic entry see Field 5F.
W89-11736

6C. Cost Allocation, Cost Sharing, Pricing/Repayment

WATER AND WATER RIGHTS TRANSFERS: A NEW POLICY FOR NEBRASKA.
Nebraska Univ.-Lincoln. Dept. of Civil Engineering.
For primary bibliographic entry see Field 6E.
W89-11160

WELFARE EFFECTS OF ALTERNATIVE WATER RATIONING SCHEMES: A CASE STUDY.
California Univ., Santa Barbara. Dept. of Economics.
L. J. Mercer, and W. D. Morgan.
Water Resources Bulletin WARBAQ, Vol. 25, No. 1, p 203-210, February 1989. 2 fig, 6 tab, 8 ref.

Descriptors: *Water shortage, *Pricing, Social costs, Drought, Economic aspects, Social aspects.

Four alternate schemes often used to deal with a water shortage are: physical rationing, lifeline with increasing block rates, rationing with resale, and pure price rationing. Each of these are analyzed using a supply-demand framework. The theoretical results are applied to a representative California water district and the welfare loss is calculated for a hypothetical 20% reduction in water supply for six different income classes. Reliance on schemes using the price mechanism in one form or another is clearly superior, in terms of welfare loss, as a means of dealing with a water shortage. (Author's abstract)
W89-11177

BUYING TOMORROW'S WATER.
V. K. Dorris.
Civil Engineering CEWRA9, Vol. 59, No. 5, p 52-54, May 1989.

Descriptors: *Financing, *Water rights, *Future planning, *Water treatment facilities, *Wastewater facilities, *Public investment, Public participation, Economic aspects, California, Texas, Project planning, Pennsylvania.

Financing public works programs by selling future access rights to potential system users in order to create expansion funds has proven successful in creating public-private partnerships for these programs. Although the access rights system is similar to development impact fees in many respects, it differs in that purchasers of access rights in essence 'own' a specified amount of service and are guaranteed rights to it at a future date. The use of private participation in public works projects has grown increasingly attractive in recent years as the flow of federal construction grant money has decreased. The sale of future access rights to water and sewer treatment plants in Escondido CA, not only provided the city with sufficient capital to finance needed plant expansion but became a profitable investment opportunity for area property owners. This funding system is also being used to finance wastewater treatment facilities in Houston, Texas and in Upper Merion Township in the Philadelphia area. (White-Reimer-PTT)
W89-11458

LONG-TERM CONTRACTS FOR LARGE USERS: AN INDUSTRY VIEWPOINT.
General Motors Corp., Detroit, MI.
For primary bibliographic entry see Field 5F.
W89-11737

FORECASTING DEMAND AND MEASURING PRICE ELASTICITY.
East Bay Municipal Utility District, Oakland, CA.
For primary bibliographic entry see Field 6D.
W89-11738

COST EFFECTIVE INVESTIGATION AND REMEDIATION OF VOLATILE-ORGANIC CONTAMINATED SITES.
Mathes (John) and Associates, Inc., Columbia, IL.
For primary bibliographic entry see Field 5G.
W89-12066

6D. Water Demand

MEASURING DROUGHT IMPACTS: THE ILLINOIS CASE.
Illinois State Water Survey Div., Champaign. Climatology and Meteorology Section.
For primary bibliographic entry see Field 2E.
W89-11158

FORECASTING URBAN WATER USE: THE IWR-MAIN MODEL.
Southern Illinois Univ. at Carbondale. Dept. of Geography.
B. Dziegielewski, and J. J. Boland.
Water Resources Bulletin WARBAQ, Vol. 25, No. 1, p 101-109, February 1989. 3 fig, 2 tab, 19 ref.

Descriptors: *Water use, *Forecasting, *Computer models, *Urban areas, Anaheim, California, Model studies.

In the current forecasting practice, future water requirements of a growing urban area are often represented as the product of the number of people to be served by the water system and an assumed quantity of gross per capita water use. A forecasting approach was developed that differs from the per capita method in two important aspects. First, it disaggregates urban water use into a large number of categories, each consisting of a relatively homogeneous group of water users. Second, it links water use in each category to factors that determine both the need for water as well as the intensity of water use. This approach is incorporated into a computerized forecasting system referred to as IWR-MAIN. The advantages of this model over the traditional per capita method are illustrated in a case study of Anaheim, California. (Author's abstract)
W89-11165

WELFARE EFFECTS OF ALTERNATIVE WATER RATIONING SCHEMES: A CASE STUDY.

California Univ., Santa Barbara. Dept. of Economics.
For primary bibliographic entry see Field 6C.
W89-11177

WESTERN IRRIGATION RESPONSE TO PUMPING COSTS: A WATER DEMAND ANALYSIS USING CLIMATIC REGIONS.
Economic Research Service, Washington, DC.
C. W. Ogg, and N. R. Gollehon.
Water Resources Research WRERAO, Vol. 25, No. 5, p 767-773, May 1989. 2 fig, 4 tab, 23 ref.

Descriptors: *Water demand, *Water costs, *Water requirements, *Irrigation requirements, Groundwater irrigation, Pumping, Irrigation, Groundwater, Economic aspects, Irrigation water, Climatic zones, Agricultural watersheds, Consumptive use, Alfalfa, Water policy, Water allocation, Costs.

An inelastic groundwater demand analysis that is based on a sample of 1927 farm observations in 16 western states drawn form the 1984 Farm and Ranch Irrigation Survey (FRIS). The farmers irrigated exclusively with groundwater. Farmers' estimates of energy costs per cubic meter for pumping groundwater served as a proxy variable for the price of water. Climatic regions were defined according to the consumptive irrigation requirements (CIR) of a reference crop, alfalfa. County level CIRs were calculated for the FRIS year, 1984. Despite pronounced differences in climate, crop mix, and irrigation requirements across the three climatic regions, the relatively low elasticity estimates for groundwater demand varied little across climatic regions. Fixed well yields, large fixed investments in irrigation equipment, or the domination of a few crops may all reduce water price influences on water applications per hectare. Narrowing the sample to include only sprinkler irrigated farms resulted in no significant change in elasticity estimates. In spite of this similarity, results indicated statistically significant differences in demand relationships associated with climate. The region with the lower irrigation water requirements clearly has a more price responsive demand for irrigation water than the rest of the west. The estimation results are most applicable to policies that directly affect the price of groundwater. Limitations regarding pricing policies, alone, should bring about water conservation or more efficient water allocation. (Friedmann-PTT)
W89-11247

WATER SUPPLY AND DEMAND IN SEDGWICK COUNTY, KANSAS.
Geological Survey, Lawrence, KS. Water Resources Div.
H. E. Bevans.
Available from Books and Open File Report Section, USGS, Box 25425, Denver, CO 80225; paper copy $1.50, microfiche $4.00. USGS Open-File Report 88-711, Fact Sheet, 1988. 2p, 1 fig, 2 tab, 5 ref.

Descriptors: *Water supply, *Water demand, *Water use, *Sedgwick County, *Kansas, Surface water, Groundwater, Water quality, Water rights.

Water supplies in Sedgwick County, Kansas, are derived from surface--and groundwater resources. During 1985, public supply, irrigation, and self-supplied industry required 38% of the 56,500 acre-ft of appropriated surface water and 57% of the 187,800 acre-ft of appropriated groundwater. If the historic (1920-80) annual population growth rate (2.8%) continues, the 126,100 acre ft of water appropriated for public-water supplies should meet demand until 2015. The quantity of potentially available water supplies was estimated by summing those resources having less than 1.00 mg/L dissolved solids. Surface water resources that meet this criterion are the Little Arkansas and Ninnescah Rivers and Cheney Reservoir. Subtracting legislated minimum streamflows for the rivers from their mean annual streamflow volumes leaves 532,000 acre-ft, which combined with the annual sustained yield of Cheney Reservoir (40,000 acre-ft) provides an estimated 572,000 acre-ft of surface water annually. Groundwater that meets the criterion was estimated by summing the annual precipitation recharge available to unconsolidated deposits in the county (78,400 acre-ft) and in the Harvey County part of the Wichita well field (13,000 acre-ft). Although more groundwater is available, withdrawals exceeding annual precipitation recharge would cause water level declines. Because less than 4% of the potentially available surface water was used for supplies in 1985 and because about 120% of the groundwater recharge was used, surface water resources have a greater potential for meeting future water use demands. (USGS)
W89-11490

WATER AVAILABILITY AND TRACHOMA.
Johns Hopkins Univ., Baltimore, MD.
S. West, M. Lynch, V. Turner, B. Munoz, and P. Rapoza.
Bulletin of the World Health Organization BWHOA6, Vol. 67, No.1, p 71-75, 1989. 5 tab, 17 ref.

Descriptors: *Epidemiology, *Developing countries, *Available water, *Human diseases, *Public health, *Water supply, *Water use, Tanzania, Pathogens, Potable water, Municipal water, Well water, Risk assessment.

As part of an epidemiological survey of risk factors for trachoma in 20 villages in the United Republic of Tanzania, the relationship of village water pumps, distance to water source, and quantity of household water to the risk of inflammatory trachoma was investigated. Also, it was determined whether there was an association between the cleanliness of childrens' faces and these water variables. No association was found between the presence of a village water supply and the prevalence of trachoma. However, the risk of trachoma in the household increased with the distance to a water source--although there was no association with the estimated daily amount of water brought into the house. Likewise, children were more likely to have unclean faces if they lived more than 30 minutes from a water source, but whether they had clean faces was not associated with the daily quantity of water brought into the household. The effect of the distance to water supply on trachoma may well reflect the value placed on water within the family, and this determines the priority for its use for hygiene purposes. The results of this study suggest that changing the access to water per se may be insufficient to alter the prevalence of trachoma without also a concomitant effort to change the perception of how water should be utilized in the home. (Author's abstract)
W89-11668

FORECASTING DEMAND AND MEASURING PRICE ELASTICITY.
East Bay Municipal Utility District, Oakland, CA.
J. A. Weber.
Journal of the American Water Works Association JAWWA5, Vol 81, No. 5, p 57-65, May 1989. 6 fig, 7 tab, 6 ref.

Descriptors: *Water rates, *Pricing, *Economic aspects, *Metropolitan water management, Time-series analysis, Management planning, Statistics, Rainfall, Temperature, Social aspects, Oakland, California, Seasonal distribution, Water demand, Projections, Estimating, Water use, Weather data collections.

The basic tools of economics and statistics were applied to water-demand forecasting and price-elasticity measurement by the East Bay Municipal Utility District (EBMUD), Oakland, California. Little expertise is required to produce good forecasting results with time-series models, which can also yield elasticity estimates if price increases are significant and the data are sufficiently disaggregated. Pooled time-series models are more demanding in their structure and data requirements, but often provide better estimates of the impact of price variables than simple time-series analyses. In the simplest form, the only data required are monthly consumption for three years or more, the associated monthly rainfall and temperature, and average monthly rainfall for a stable period (e.g., 10 yr or more). A seasonal index alone typically will explain about 95% of the variation in consumption. It is important to include weather variables, however, so that data can be normalized, that is, expressed for a normal weather pattern. Small real rate changes are not likely to result in defined reduction in consumption among high-income customers, but could do so among low-income customers. Disaggregation or segmentation of consumption is essential to minimize the cross-sectional influences that are embedded in most time-series data. Combining time-series data with cross-sectional attributes can be a very effective method of analysis for forecasting and measuring price elasticity. It isolates the differential response among cross-sectional characteristics that are obscured in pure time-series analysis. At EBMUD, significant elasticities, in the range of -0.1 to -0.25, were identified for summer months, resulting primarily from the implementation of elevation surcharges of 25 and 50% for two elevation bands. It is doubtful that normal average rate increases, which averaged 4.6% during this period, would have yielded measurable price elasticity. (Rochester-PTT)
W89-11738

OVERALL EFFECT ON ANNUAL COSTS OF A REDUCTION IN WATER USE WITH SEPARATE METERING OF FLATS IN PRETORIA.
Water Research Commission, Pretoria (South Africa).
For primary bibliographic entry see Field 3D.
W89-11747

MULTIDISCIPLINARY PLANNING AND MANAGING OF WATER REUSE.
King Abdulaziz Univ., Jeddah (Saudi Arabia). Dept. of Civil Engineering.
For primary bibliographic entry see Field 5F.
W89-11806

WEST BRANCH SUSQUEHANNA RIVER SUBBASIN: LOW FLOW MANAGEMENT FRAMEWORK PLAN.
Susquehanna River Basin Commission, Harrisburg, PA.
D. W. Heicher, and G. H. Hirschel.
Susquehanna River Basin Commission Publication No. 121, March 1989. 192p, 18 fig, 82 tab, 34 ref, 4 append.

Descriptors: *Watershed management, *Water use, *Water management, *Water demand, *Low flow, *Susquehanna River, Consumptive use, Interstate commissions, Water supply, Streamflow forecasting, Water storage, Management planning, Flow velocity, Streamflow.

This report is the third in a series of low flow management framework plans prepared by the Susquehanna River Basin Commission (SRBC). The objectives of these reports are to identify existing and potential water supply problems, provide guidance for programs of the SRBC and other resource agencies, and provide the foundation for future water supply planning. The SRBC framework plans use the 7-day 10-year low flow (Q7-10) value as an indicator to identify historical low flow periods, and to determine potential water supply deficits during a repeat of the most severe historical low flow period. In general, upstream consumptive use presently ranges from about 2% to 11% of the Q7-10 value at the outlets of major stream sections in the subbasin. Total consumptive use in the subbasin under baseline low flow conditions is estimated to be 44.29 million gallons per day (MGD). Consumptive use during potential low flow conditions in the year 2010 is projected to be about 45.91 MGD. This report estimates that if meteorological conditions producing the 1930 drought were repeated under present conditions, about 25,500 acre-ft of water would be required to maintain Q7-10 flows at the mouth of the West Branch Susquehanna River. About the same amount of water would be required if the 1930 drought were to be repeated in the year 2010. The amount of water storage needed to maintain flows at the Q7-10 value at the outlet of each stream section is also provided in this report. (Lantz-PTT)
W89-12103

6E. Water Law and Institutions

WATER AND WATER RIGHTS TRANSFERS: A NEW POLICY FOR NEBRASKA.
Nebraska Univ.-Lincoln. Dept. of Civil Engineering.
M. W. Gilliland, G. P. Wallin, and R. Smaus.
Water Resources Bulletin WARBAQ, Vol. 25, No. 1, p 49-61, February 1989. 9 fig, 1 tab, 12 ref.

Descriptors: *Water transfer, *Water rights, *Water policy, *Legislation, *Water costs, *User charges, Economic aspects, Social aspects, Legal aspects, Water permits, Permits.

Nebraska has abundant supplies of high quality surface and ground water. The U.S. Supreme Court decision in 1982, declaring groundwater to be an article of commerce, is widely perceived as giving neighboring states easier access to Nebraska water. In 1987 the Nebraska Legislature called for the development of a new water policy for Nebraska that would promote the economically efficient use of water, yet protect the environment as well as the rights of individuals (e.g., third parties) and the public. Through an interagency study employing the extensive public involvement process, a policy to be recommended to the Legislature in 1989 emerged. The policy revises the basic definition of water rights and transfers and eliminates most of the inconsistencies in the water allocation system by treating most types of water resources and water users, and most locations of use similarly in the permitting process. (The principal exception is the individual irrigator using ground water on the overlying land where overlying land is one government surveyed section; such use is not defined to be a transfer nor is a permit required.) An impact assessment would be required of most new water uses except on site uses of groundwater. Compensation measures could be specified as a condition of the permit where appropriate. The permit would be issued only if the benefits of the proposed transfer clearly outweigh adverse effects that could not be avoided or effectively compensated. The policy allows for the sale or lease of 'salvaged' water. It calls for the State to facilitate transfers by acting as a clearinghouse for potential buyers and sellers, and allows the State to sponsor water projects. An annual fee to be paid by many water users, in order to provide a fund for compensation and for state sponsored water projects, was proposed, but met with extensive opposition. Thus, the policy recommends only that the Legislature examine potential funding programs and equitable user fees. (Author's abstract)
W89-11160

CONFLICT ANALYSIS OF THE SHOAL LAKE SUBDIVISION.
Manitoba Univ., Winnipeg. Dept. of Civil Engineering.
B. Lussier, G. E. Mohr, and I. C. Goulter.
Water Resources Bulletin WARBAQ, Vol. 25, No. 1, p 111-116, February 1989. 1 fig, 3 tab, 13 ref.

Descriptors: *Water supply, *Conflict analysis, *Governmental interrelations, Shoal Lake, Manitoba, Canada, Housing, Indians.

The techniques of conflict analysis derived from game theory were applied to the Shoal Lake water supply conflict in southeastern Manitoba, Canada. The issue of conflict is the desire of an Indian band in the area to build cottage lots near the intake for water supply for the City of Winnipeg. The City contends that such a development would seriously affect the quality of water supplied to the City, thereby increasing its treatment costs significantly. The four major players defined for the conflict are the City of Winnipeg, Indian Band No. 40, the Province of Manitoba, and the Federal Department of Indian and Northern Affairs. The results of the conflict analysis suggest that the introduction of the provincial and federal government into the conflict will not assist significantly in its resolution and that further progress on the resolution is unlikely until the results of the Federal Environment Assessment Review office hearing become available. (Author's abstract)
W89-11166

IMPACT OF STOCKWATERING PONDS (STOCKPONDS) ON RUNOFF FROM LARGE ARIZONA WATERSHEDS,
Arizona Attorney General's Water Rights Adjudication Team, Phoenix.
M. M. Milne, and D. W. Young.
Water Resources Bulletin WARBAQ, Vol. 25, No. 1, p 165-173, February 1989. 7 fig, 28 ref.

Descriptors: *Legal aspects, *Watershed management, *Water resources management, *Water rights, *Stockwatering ponds, River basins, Gila River Basin, Judicial decisions, Runoff, Arizona.

Major water rights adjudications involving the Little Colorado River Basin and Gila River Basin are presently underway within Arizona. Water resource managers are faced with the prospect of evaluating and regulating tens of thousands of water diversions and uses. Stockponds comprise a large percentage of the total number of water diversions within these basins. Water balance studies conducted on the Little Colorado River watershed above Lyman Lake and on the Gila River watershed above Solomon, Arizona, indicate that the impact of stockponds on the water available to downstream users is insignificant when compared to total watershed production. Considering that there are an estimated 25,000 stockponds in the Gila River basin alone, rigorous case-by-case investigations and stringent regulation of individual stockponds may be impractical and unwarranted. Therefore, stockpond claims within the context of the general adjudication process may be effectively handled by partial summary judgement, thereby allowing the court to concentrate on major water users and water rights issues. (Author's abstract)
W89-11173

UNIFIED MANAGEMENT OF SURFACE AND GROUNDWATER QUALITY THROUGH CLEAN WATER ACT AUTHORITIES.
Tennessee Valley Authority, Knoxville. Environmental Quality Staff.
For primary bibliographic entry see Field 5G.
W89-11278

STATUS OF INSTREAM FLOW LEGISLATION AND PRACTICES IN NORTH AMERICA.
EA Engineering, Science, and Technology, Inc., Lafayette, CA.
D. W. Reiser, T. A. Wesche, and C. Estes.
Fisheries (Bethesda), Vol. 14, No. 2, p 22-29, Mar/Apr 1989. 2 fig, 1 tab, 17 ref.

Descriptors: *Water law, *Legislation, *Instream flow, *Legal aspects, *Regulations, *Flow requirements, Fisheries, Research priorities, Legislation, Surveys, North America.

The results of two nonstatistical surveys (completed in 1981 and 1986) that solicited information from state and federal agencies concerning instream flow issues and practices in North America are presented. Fifteen of the 46 states reported legislative recognition of instream flows for fisheries protection. In Canada, individual provinces generally lacked instream flow legislation although federal legislation existed that could be used. The most commonly applied method (in use in 38 states or provinces) for assessing instream flow requirements, as reported in the survey, was the Fish and Wildlife Service Instream Flow Incremental Methodology (IFIM). In addition, the Tennant Method is frequently used in selected states and provinces, and other commonly applied methods were the Wetted Perimeter, the ABF, and the 7Q10. Professional judgment was also cited as a viable and currently used approach. Major research needs cited by survey respondents included (1) more species habitat information and preference curves, (2) techniques for determining instream flows for atypical conditions, and (3) testing of fish habitat:flow:production relationships. (Author's abstract)
W89-11450

MANAGEMENT FUNCTIONS FOR EFFECTIVE CONTROLS OF GROUNDWATER CONTAMINATION.
Wisconsin Univ.-Milwaukee. Dept. of Civil Engineering.
For primary bibliographic entry see Field 5G.
W89-11489

PROCESS FOR COOPERATION ON INTERNATIONAL RIVER BASIN PROJECTS.
Ministry of Environment and Water Management, Budapest (Hungary).
L. S. Nagy.
Regulated Rivers Research and Management RRRMEP, Vol. 3, No. 1-4, p 355-359, Jan-Apr 1989. 1 fig, 1 tab.

Descriptors: *Interagency cooperation, *River basin development, *International agreements, *International commissions, *Data acquisition, *Project planning, *Navigation, Hydraulics, United Nations, Czechoslovakia, Hungary, Inland waterways, Feasibility studies, Design criteria, Water resources management, Hydroelectric power, Danube River.

A process for cooperation in international river basin projects is described in which the significance of multilateral projects is stressed and the most important tasks of common preparation are considered. The potential role of the United Nations and other international organizations are demonstrated. The problems associated with planning the Bos (Gabcikovo)-Nagymaros Barrage Project are used to provide an example of the way in which a general method can be adapted to international projects by the use of a 33-step scheme. This project, a joint undertaking of Czechoslovakia and Hungary, entails an integrated and coordinated system of hydraulics, navigation, water resources management, and hydroelectric power development. The sites of the individual component structures and the engineering parameters thereof are fitted into the Danube development program and consequently meet the requirements established for the unified European waterways system. The preparatory work for multilateral cooperation in a river basin project can, in general, be realized in the following steps: (1) Emergence of need, formulation of objectives, declaration of intentions; (2) Setting up of a joint forum, specification of preliminary agreement; (3) Study of complexity; (4) Selection, collection and processing of data, identification of planning and design criteria; (5) Joint feasibility study, impact analysis, cost-benefit analysis; allocation of costs and benefits; (6) Detailed plans and designs, organization; and (7) Agreement on execution and operation. (White-Reimer-PTT)
W89-11723

COORDINATION OF PUBLIC AND PRIVATE ACTION: A CASE STUDY OF LAKE RESTORATION.
Florida Univ., Gainesville. Dept. of Food and Resource Economics.
For primary bibliographic entry see Field 5G.
W89-11792

TRANSITIONS IN MIDWESTERN GROUND WATER LAW.
Illinois State Water Survey Div., Champaign.
J. A. Bowman, and G. R. Clark.
Water Resources Bulletin WARBAQ, Vol. 25, No. 2, p 413-420, April 1989. 2 fig, 23 ref.

Descriptors: *Legislation, *Legal aspects, *Water law, *Illinois, *Indiana, *Iowa, *Michigan, *Minnesota, *Missouri, *Ohio, *Wisconsin, Groundwater management, Regulations.

The evolution of groundwater law in eight states in the Midwest (Illinois, Indiana, Iowa, Michigan, Minnesota, Missouri, Ohio, and Wisconsin) is examined, and a review of transitions in groundwater doctrines is presented. Two underlying themes in changing groundwater management are communicated. First, groundwater law is evolving from private property rules of capture based on the absolute ownership doctrine to rules requiring conservation and sharing of groundwater as a public resource. Second, in both courts and state legisla-

tures, a proactive role of groundwater management is emerging, again, with an emphasis on sharing. Both of these trends are apparent in the Midwest. In the last decade midwestern states have: (1) seen significant shifts in reciprocal or mutually dependent nature of groundwater rights, and (2) seen increased legislative development of comprehensive groundwater management statutes that emphasize the reciprocal liabilities of groundwater use. These trends are examined and groundwater management programs discussed for eight states in the Midwest. (Author's abstract)
W89-11804

CANADIAN CONFERENCE ON MARINE ENVIRONMENTAL QUALITY: PROCEEDINGS.
For primary bibliographic entry see Field 5G.
W89-11852

UNEP GUIDELINES FOR THE PROTECTION OF THE MARINE ENVIRONMENT AGAINST POLLUTION FROM LAND-BASED SOURCES: THEIR IMPLEMENTATION IN THE MEDITERRANEAN.
United Nations Environment Programme, Athens (Greece). Co-ordinating Unit for the Mediterranean Action Plan.
For primary bibliographic entry see Field 5G.
W89-11853

LONDON DUMPING CONVENTION--ITS DEVELOPMENT AND SIGNIFICANCE TO MARINE POLLUTION CONTROL.
Scientific Group on Dumping of the London Dumping Convention, Irish Science and Technology Agency, Shannon, Ireland.
For primary bibliographic entry see Field 5E.
W89-11854

CANADIAN LEGISLATION PERTAINING TO THE PREVENTION AND CONTROL OF MARINE POLLUTION.
Department of the Environment, Ottawa (Ontario).
G. Cornwall, P. Higgins, and J. Karau.
IN: Canadian Conference on Marine Environmental Quality: Proceedings, February 29-March 3, 1988, Halifax, Nova Scotia. The International Institute for Transportation and Ocean Policy Studies, 1236 Henry St., Halifax, Nova Scotia, Canada. 1988. p 47-57, 3 tab, 8 ref.

Descriptors: *Canada, *Legislation, *Marine environment, *Water pollution prevention, *Water pollution control, Federal jurisdiction, Water quality management, International commissions, Administrative agencies.

Canada has a special interest in and responsibility to the 1987 Declaration by the World Commission on Environment and Development that 'sustainable development, if not survival itself, depends on significant advances in the management of the oceans.' The responsibility for environmental and economic matters is shared between the federal, provincial and territorial governments. This makes consultation and cooperation essential to delivering marine environmental quality to Canadians. At present, at least twenty-two federal acts, administered by five federal departments relate to the marine environment. In addition, at least twenty provincial or territorial acts are administered by the six major coastal provinces and two territories. (See also W89-11852) (Author's abstract)
W89-11855

SOCIAL, ECONOMIC, INSTITUTIONAL AND LEGAL CONSIDERATIONS IN THE MANAGEMENT OF LAND-BASED SOURCES OF MARINE POLLUTION.
Dalhousie Univ., Halifax (Nova Scotia). Marine Affairs Program.
For primary bibliographic entry see Field 5G.
W89-11856

CONTROL OF LAND-BASED POLLUTANTS FROM THE EXPERIENCES OF THE PARIS COMMISSION.
Secretary of the Oslo and Paris Commissions, New Court, 48 Carey St., London, United Kingdom.
For primary bibliographic entry see Field 5G.
W89-11858

GREAT LAKES WATER QUALITY AGREEMENT: A MANAGEMENT FRAMEWORK FOR MULTI-JURISDICTIONAL ACTION.
Environment Canada, Toronto (Ontario). Great Lakes Environment Office.
For primary bibliographic entry see Field 5G.
W89-11866

AGRICULTURAL CHEMICALS IN GROUND WATER: PROPOSED PESTICIDE STRATEGY.
Environmental Protection Agency, Washington, DC. Office of Pesticides and Toxic Substances.
For primary bibliographic entry see Field 5G.
W89-11881

AGRICULTURAL CHEMICALS IN GROUND WATER: SUMMARY MINUTES FROM THE 1987 PESTICIDE STRATEGY WORKSHOP.
Environmental Protection Agency, Washington, DC. Office of Pesticides and Toxic Substances.
For primary bibliographic entry see Field 5G.
W89-11882

SUPERFUND.
Environmental Protection Agency, Cincinnati, OH. Hazardous Waste Engineering Research Lab.
For primary bibliographic entry see Field 5G.
W89-11900

ANALYSIS OF TECHNICAL ISSUES RELATED TO REAUTHORIZATION OF THE CLEAN WATER ACT.
Environmental Research and Technology, Inc., Atlanta, Georgia. July 1982. 192p, 32 fig, 38 tab, 93 ref, 2 append.

Descriptors: *Water law, *Pollutant identification, *Clean Water Act, *Legislation, *Water quality control, *Wastewater treatment, Nonpoint pollution sources, Water pollution prevention, Regulations, Standards, Water quality management, Industrial wastewater, Municipal wastewater, Optimum development plans, Priority pollutants.

Environmental Research and Technology, Inc. (ERT) has examined certain issues and available data related to the reauthorization of the Clean Water Act (1982). This study documents the progress that has been made in the reduction of point and non-point source discharges since the enactment of the 1972 and 1977 Amendments, and evaluates the presence of toxic pollutants in industrial and municipal wastewaters. Also considered is the need for additional controls beyond best practicable control technology (BPT) currently available and secondary treatment to reduce toxics in point source discharges. The study indicates that industrial sources are not the major source of priority pollutants discharged to surface waters. On a national basis, the priority pollutant loading from industrial point sources is estimated to constitute only 3% to 10% of the total loadings. The study also indicates that secondary treatment and BPT technologies remove substantial quantities of toxic pollutants. Based upon these findings, it appears that the current requirement for additional controls beyond BPT should be applied selectively only after a site specific evaluation indicates that measureable and realistic water quality improvements can be obtained. Specific findings are: (1) in most cases BPT accomplishes high removals of conventional pollutants (85-95+%) and priority pollutants (60-95%), and reduces or eliminates the presence of aquatic toxicity in industrial discharges; (2) the universal application of best available technology economically achievable (BAT) may not significantly improve water quality; (3) based on data developed by EPA, lower concentrations of priority pollutants in effluents will not necessarily be achieved, nor better quality sludges produced with the implementation of pretreatment programs; and (4) data on the frequency of detection of the priority pollutants indicate that many compounds are candidates for removal from the priority pollutant list. (Lantz-PTT)
W89-11906

PROJECT AQUARIUS: AREAWIDE WATER QUALITY MANAGEMENT PLAN FOR EL PASO AND TELLER COUNTIES.
Pikes Peak Area Council of Governments, Colorado Springs, CO.
For primary bibliographic entry see Field 5G.
W89-11907

LIABILITY FOR AND CLEANUP OF OIL AND HAZARDOUS WASTE: LEGAL AND TECHNICAL ANSWERS TO A COMPLEX QUESTION.
Nutter, McClennen and Fish, Boston, MA.
A. Rogers, and J. Loitherstein.
IN: Proceedings of the FOCUS Conference on Eastern Regional Ground Water Issues, September 27-29, 1988, Stamford, Connecticut. National Water Well Association, Dublin, Ohio, 1988. p 135-157, 3 fig.

Descriptors: *Liability, *Cleanup operations, *Legal aspects, *Regulations, *Hazardous wastes, Oil spills, Economic aspects, Fate of pollutants, Water pollution treatment, Environmental engineering, Case studies.

This paper addresses legal and technical issues raised by the discovery of oil or hazardous substances or waste on property where the owner seeks refinancing or plans to convey the property. The statutory framework that is the background for these events is slightly different in each state, but as a general matter, the state statutes are based upon and similar to the federal hazardous waste cleanup statute, the Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA). In the context of liability, the lawyer and the engineer must work together in a cooperative spirit to further the client's interest, and their respective tasks overlap at several points. In many cases, the engineer will be retained by the attorney on behalf of the client in order to make all of the engineer's written work confidential and to protect it from discovery by other parties. Two case studies are presented which highlight some of the ways in which engineers and attorneys can work together for the benefit of their clients. (See also W89-11916) (Lantz-PTT)
W89-11924

GROUNDWATER PROTECTION INITIATIVES FOR THE PUBLIC DRINKING WATER SUPPLY IN THE TOWN OF CHESHIRE, CONNECTICUT.
South Central Connecticut Regional Water Authority, New Haven.
C. F. Adams.
IN: Proceedings of the FOCUS Conference on Eastern Regional Ground Water Issues, September 27-29, 1988, Stamford, Connecticut. National Water Well Association, Dublin, Ohio, 1988. p 411-426, 3 fig, 3 tab, 9 ref.

Descriptors: *Drinking water, *Water supply, *Connecticut, *Water quality control, *Regulations, *Groundwater quality, Aquifers, Groundwater pollution, Land use, Education, Public participation, Groundwater movement, Model studies, Water treatment facilities, Zoning.

Approximately 80% or 19,500 of Cheshire's residents are served by the South Central Connecticut Regional Water Authority (RWA) public water supply wells located in north and south Cheshire. Groundwater contamination from volatile organic chemicals (VOCs) has resulted in the need for construction of additional water treatment facilities for both wellfields at a combined cost of $2.2 million. With the increased knowledge of risk and existing potential for contamination of these groundwater supplies, the RWA has requested the town of Cheshire to consider a multi-faceted program created to increase protection of the groundwater quality. The program initiatives encompass: (1) zone change from industrial use to lower risk land use; (2) revision of the existing aquifer protec-

tion regulation; and (3) development of an aquifer protection ordinance to reduce risk of contamination from existing land use activities. A 2-D groundwater flow model was utilized to delineate the zone of contribution. Based on the geohydrology, the aquifer protection regulations and ordinance establish two contiguous overlay districts around each wellfield. The regulations specify that all proposed uses conform to performance and design standards unless equal protection of groundwater quality utilizing an alternative method can be demonstrated. The ordinance provides a time frame for existing land uses to comply with the performance and design standards. Public education was a top priority in the initiatives, focusing on such issues as: (1) source of public water supply; (2) what is an aquifer; (3) vulnerability of groundwater to contamination; (4) how land use activities can impact the quality of groundwater; and (5) promoting a sense of stewardship among residents for the protection of a valuable and irreplaceable resource. (See also W89-11916) (Lantz-PTT)
W89-11940

ANALYSIS OF SEPTIC TANK SURVIVAL DATA FROM 1952 TO 1972 IN FAIRFAX COUNTY VIRGINIA,
Fairfax County Health Dept., VA. Div. of Environmental Health.
For primary bibliographic entry see Field 5E.
W89-11960

CASE HISTORY OF A CONTAMINATED GROUNDWATER DISCHARGE TO SURFACE WATER PURSUANT TO AN ACL.
Eder Associates, Locust Valley, NY.
For primary bibliographic entry see Field 5G.
W89-12010

USING ACLS TO ESTABLISH REMEDIAL DESIGN GOALS.
Environmental Science and Engineering, Inc., Gainesville, FL.
W. A. Tucker, R. C. Morgan, A. B. Chandler, J. A. Kountzman, and P. Kosalwat.
IN: HWHM 88: Hazardous Wastes and Hazardous Materials. Proceedings of the 5th National Conference held April 19-21, 1988, Las Vegas, Nevada. 1988. p 251-255, 3 fig, 9 ref. US Army Toxic and Hazardous Materials Agency Contract DAAK 11-83-D-0007.

Descriptors: *Water pollution prevention, *Alternate Concentration Limits, *Regulations, *Water pollution control, Superfund, Groundwater quality, Water pollution effects.

The development of Alternate Concentration Limits (ACLs), although intended for use at hazardous waste facilities permitted under RCRA, has proven useful in the Superfund program. The use of ACLs has proven to be useful in the remediation investigation/feasibility study (RI/FS) preparations and record of decision (ROD) preparations pursuant to this design objective for the Superfund program. ACLs have been prepared for two hazardous waste sites currently listed on the National Priority List (NPL) and a State site. At each site, an endangerment assessment has been performed that meets the substantive requirements for an ACL. Through the endangerment assessment process, the two criteria used to evaluate ACL requests have been assessed. The first criterion involves assessing the potential adverse effects on groundwater quality and the second involves assessing the potential adverse effects on hydraulically connected surface water quality. Under Superfund Amendments and Reauthorization Act of 1986, the design objectives must be equivalent to ACLs for many contaminants since the applicable or relevant and appropriate requirements (ARARs) for groundwater are the RCRA groundwater protection standards. These standards, incorporated through state regulations at one of the sites, call for maximum contaminants levels (MCLs), background levels or ACLs. Since MCLs did not exist for some of the contaminants of concern at these sites, and background was below detection limits, the de facto ARARs were ACLs. (See also W89-12002) (Lantz-PTT)
W89-12035

CLOSING A HAZARDOUS WASTE FACILITY: ENVIRONMENTAL CONCERNS.
Environmental Science and Engineering, Inc., Salt Lake City, UT.
For primary bibliographic entry see Field 5E.
W89-12042

UNDERGROUND STORAGE TANK REGULATIONS: STATUS AND DIRECTION,
Environmental Protection Agency, Seattle, WA. Region X.
J. Cabreza.
IN: HWHM 88: Hazardous Wastes and Hazardous Materials. Proceedings of the 5th National Conference held April 19-21, 1988, Las Vegas, Nevada. 1988. p 347-350.

Descriptors: *Water pollution control, *Underground storage, *Legislation, Regulations, Federal jurisdiction, Leaching, Hazardous wastes, Waste storage.

Leaking underground storage tanks (USTs) pose a number of environmental and safety threats, including a fire and explosion hazards and water, soil and air contamination. As a result of several well-publicized leak incidents and a general growing awareness of tank problems. Congress passed the 1984 amendments to the Resource Conservation and Recovery Act (RCRA). These amendments established a new Subtitle I, regulating USTs containing petroleum and hazardous substances. The UST program is based on a franchise approach. As such, implementation is expected to occur primarily on the state and local level rather than on the federal level. One reason for this approach is the very large size of the regulated community. To allow this approach to function, a high degree of flexibility has been built into the program and each state has a great deal of freedom in its approach to program implementation. The proposed rule is comprehensive, covering notification requirements, spill and overfill controls, performance standards for both new and existing petroleum and hazardous substance tanks, release detection, reporting and record keeping, corrective action and closure requirements. Separate rules cover financial responsibility and state program approval requirements. A final rule package is expected in early summer, 1988, and most parts should become effective 90 days after promulgation. (See also W89-12002) (Lantz-PTT)
W89-12048

STATE REGULATORY APPROACHES TO MANAGEMENT OF MINING WASTES.
CDM Federal Programs Corp., Fairfax, VA.
W. L. Sydow, D. L. Derkics, and J. W. Deichmann.
IN: HWHM 88: Hazardous Wastes and Hazardous Materials. Proceedings of the 5th National Conference held April 19-21, 1988, Las Vegas, Nevada. 1988. p 359-363, 2 fig, 1 tab, 5 ref.

Descriptors: *Waste management, *Mine wastes, *Legislation, Solid wastes, State jurisdiction, Federal jurisdiction, Hazardous wastes, Project planning, Coal mining.

The US EPA is developing a regulatory program under Subtitle D of the Resource Conservation and Recovery Act (RCRA) for the management of solid wastes resulting from the extraction, beneficiation and processing of non-fuel ores and minerals. Releases of contaminants can occur through mine waste management practices, usually through leakage to groundwater or surface water. In its regulatory determination of July 3, 1986, the EPA concluded that the hazardous waste management standards under RCRA 'are likely to be environmentally unnecessary, technically infeasible or economically impractical when applied to mining waste.' The EPA has since been studying technical and policy issues related to the control of potentially adverse effects of mining waste on human health and the environment, including a literature review of related regulations in all the states and interviews with agency representatives in selected states an overview of the range of regulatory scenarios currently in force in the states is presented. Many states have adopted comprehensive programs to control the effects of coal mining activity on the environment. However, the regulation of solid wastes from mining and processing of non-fuel minerals varies considerably from state to state. The EPA will use the information assembled in this review to determine the most appropriate manner to regulate mining waste while avoiding duplication of state programs. Through this review, the EPA will: (1) identify effective components of existing programs, (2) identify implementation problems and success associated with particular regulation strategies, and (3) consider alternative implementation strategies for integrating a federal program into existing state programs. (See also W89-12002) (Author's abstract)
W89-12050

COUNTY SPECIFIC HAZARDOUS WASTE MANAGEMENT PLANS.
Brown, Vence and Associates, San Francisco, CA.
For primary bibliographic entry see Field 5G.
W89-12071

MUNICIPAL HAZARDOUS MATERIALS MANAGEMENT PROGRAMS IN CALIFORNIA.
PRC Environmental Management, Inc., San Francisco, CA.
For primary bibliographic entry see Field 5E.
W89-12072

CORRECTIVE ACTION AT SOLID WASTE MANAGEMENT UNITS UNDER A RCRA PERMIT; AN AUTHORIZED STATE'S EXPERIENCE.
Georgia Environmental Protection, Atlanta.
For primary bibliographic entry see Field 5E.
W89-12073

6G. Ecologic Impact Of Water Development

EFFECTS OF VARIATIONS IN RECHARGE ON GROUNDWATER QUALITY.
Kansas State Geological Survey, Lawrence.
D. O. Whittemore, K. M. McGregor, and G. A. Marotz.
Journal of Hydrology JHYDA7, Vol. 106, No. 1/2, p 131-145, March 30, 1989. 3 fig, 4 tab, 24 ref.

Descriptors: *Groundwater quality, *Surface-groundwater relations, *Geochemistry, *Water chemistry, Recharge, *Aquifer characteristics, Municipal water, Regional variation, Kansas.

Regional variations in the quality of municipal well waters in Kansas were analyzed in relation to long-term changes in recharge and aquifer characteristics. The predominant regional effect of recharge on municipal groundwater quality in Kansas is the dilution of mineralized water in aquifers with relatively shallow water tables. The individual dissolved constituents contributing most to the water quality variations are sulfate and chloride, and the calcium and sodium accompanying them, which are derived from the dissolution of evaporite minerals within the aquifer of from saline formation water in bedrock underlying the aquifer. The relationship between recharge and groundwater quality variation can be quantified by associating certain climatic indices, especially the Palmer Drought Index, with quality observations. The response time of the maximum water quality change relative to the occurrence of drought or substantial recharge ranges from a month to 3 years depending on the aquifer characteristics, and is generally proportional to the saturated thickness and specific yield. The response time is also affected by discharge to and recharge from nearby streams and by the well construction, particularly the placement of the screened interval, and pumping stress. (Author's abstract)
W89-11378

EVALUATION OF NAVIGATION DAM EFFECTS ON RIVERBANKS.
Louisville Univ., KY. Dept. of Civil Engineering.
For primary bibliographic entry see Field 2J.
W89-11475

AQUIFER-SYSTEM COMPACTION, TUCSON BASIN AND AVRA VALLEY, ARIZONA.
Geological Survey, Tucson, AZ. Water Resources Div.
For primary bibliographic entry see Field 2F.
W89-11483

INTEGRATED APPROACH TO HYDROPOWER IMPACT ASSESSMENT: II. SUBMERGED MACROPHYTES IN SOME NORWEGIAN HYDROELECTRIC LAKES,
Norsk Inst. for Vannforskning, Oslo.
B. Rorslett.
Hydrobiologia HYDRB8, Vol. 175, No. 1, p 65-82, April 29 1989. 4 fig, 7 tab, 57 ref.

Descriptors: *Submerged plants, *Norway, *Environmental impact, *Hydroelectric plants, *Powerplants, *Vegetation effects, *Macrophytes, *Environmental effects, *Lakes, Aquatic environment, Ecotypes, Species diversity, Water level fluctuations, Plant growth, Aquatic plants, Ecological effects.

The submerged aquatic vegetation of 17 Norwegian lakes is described and related to the environmental impacts that result from hydroelectric power (HEP) use of these lakes. Largely based upon physiographic features, three main community types are discerned: shallow-water, mid-depth, and deep-water communities. The aquatic macrophytes are classified into a plant strategy framework. This classification suggests that these macrophytes frequently exhibit combined traits of the 'S' (stress-tolerating), 'R' (ruderal), and 'C' (competitive) strategies. A plant-strategy index for the lakes is derived from the species classification and related to their HEP use. Broadly, the response features of hydrolake vegetation are: (1) a decline in species richness; (2) the gradual disappearance of the shallow-water and mid-depth communities; (3) a conspicuous absence of vascular submerged macrophytes in storage hydrolakes when lake levels change more than 7 m annually, and (4) an increased incidence of species possessing plant strategies of the ruderal (R) type. The literature is reviewed concerning the environmental impact of hydropower schemes on similar Norwegian lakes, including the question of hydrolake support of an impoverished flora, plant growth strategy schemes in the presence of hydropower, and the influence of hydropower on vertical colonized ranges. (Friedmann-PTT)
W89-11655

EFFECTS OF HYDROPOWER DEVELOPMENT ON AQUATIC MACROPHYTES IN NORWEGIAN RIVERS: PRESENT STATE OF KNOWLEDGE AND SOME CASE STUDIES.
Norsk Inst. for Vannforskning, Oslo.
B. Rorslett, M. Mjelde, and S. W. Johansen.
Regulated Rivers Research and Management RRRMEP, Vol. 3, No. 1-4, p 19-28, Jan-Apr 1989. 5 fig, 2 tab, 24 ref. Norwegian Institute for Water Research Project E-88412.

Descriptors: *Dam effects, *Aquatic plants, *Macrophytes, *Norway, *Hydroelectric plants, Flow pattern, Carex, Equisetum, Juncus, Case studies, Ecological effects, Aquatic weed control.

Increased winter flows and a concomitant lack of ice-cover are features found downstream of power installations on many Norwegian hydrorivers. The objectives of this study were to: (1) assess the changes in aquatic macrophyte abundance subsequent to hydroelectric power development; and (2) evaluate the environmental conditions under which nuisance growths of macrophytes are likely to occur. Norwegian data were compiled and assessed and case studies were outlined in order to show the variety of situations under which prolific growths of macrophytes might result. Plans to control nuisance growths of Juncus bulbosus L. on the River Otra include sudden shutdowns of the Brokke power plant during mid-winter in conjunction with controlled stage draw-down within the weed-infested tailwater areas. Following the freezing-in of the weed beds, recommenced operation of the plant should generate a scouring flood which is likely to adversely affect the remaining Juncus beds. No definitive steps have been taken to control macrophytes on the river Suldalslagen, but scouring floods are considered a possible, but little explored, mitigative measure. The river Borselva has heavy encroachment by Carex rostrata and Equisetum fluviatile L. It is believed that predevelopment flashy flow regime prevented accumulation of fine sediments and thereby macrophyte growths were largely avoided. An important point is that whenever macrophytes develop profusely, it is related to changes within the hydrology regime. The more important aspects of hydrological changes are either increased winter flows (for submersed species), or decreased annual flows (for emergent macrophytes). Under the post-regulation conditions, opportunistic and competitive species with multiple regenerating strategies can thrive and proliferate. (White-Reimer-PTT)
W89-11694

SEASONAL VARIATION IN THE COMPOSITION OF THE DRIFT BELOW A PEAKING HYDROELETRIC PROJECT.
Tennessee Cooperative Fishery Research Unit, Cookeville.
J. B. Layzer, T. J. Nehus, W. Pennington, J. A. Gore, and J. M. Nestler.
Regulated Rivers Research and Management RRRMEP, Vol. 3, No. 1-4, p 29-34, Jan-Apr 1989. 1 fig, 4 tab, 21 ref.

Descriptors: *Dam effects, *Aquatic drift, *Reservoir operation, *Hydroelectric power, *Tennessee, Seasonal variation, Benthos, Tailwater, Species composition, Aquatic insects.

Downstream drift from a peaking hydroelectric project on the Caney Fork River, Tennessee was measured with 0.5 m diameter nets. The relative contribution of the terrestrial, lentic, and lotic environments to stream drift varied seasonally. Stream benthos (primarily Chironomidae and Lirceus fontinalis) occurred in the drift throughout the year; however, their relative importance varied seasonally. Daphnia sp. from the reservoir also occurred in the drift year round with the highest densities in fall and spring when they were the predominant species in the drift. In summer, terrestrial insects apparently utilized exposed portions of the river bed during periods of no power generation. In June as the river stage increased following initiation of generation, adult terrestrial insects became a major component of the drift. Threadfin shad (Dorosoma petenense) dominated the biomass in the drift during December. Although the importance of stream benthos to fish populations is generally recognized, the contribution of the terrestrial and upstream reservoir environments to the forage base in the tailwater may also be important and should be considered in developing management strategies for tailwater fisheries. (Author's abstract)
W89-11695

INSTREAM FLOW PREDICTIONS AND MANAGEMENT OPTIONS FOR BIOTA AFFECTED BY PEAKING-POWER HYDROELECTRIC OPERATIONS.
Tulsa Univ., OK. Faculty of Biological Science.
J. A. Gore, J. M. Nestler, and J. B. Layzer.
Regulated Rivers Research and Management RRRMEP, Vol. 3, No. 1-4, p 35-48, Jan-Apr 1989. 10 fig, 1 tab, 31 ref.

Descriptors: *Reservoir operation, *Instream flow, *Stream biota, *Dam effects, *Aquatic habitats, *Hydroelectric power, Hydraulic profiles, Flow fluctuations, Sculpin, Chronic effects, Surges.

Recent studies on the impact of peaking hydropower have indicated that impacts directly associated with peaking releases can be categorized as those which result from the hydraulic surge during start-up of generation and the chronic effects of frequent flow fluctuations to biota occupying the fluctuation zones. The instream flow incremental methodology (IFIM) was not designed for application to dynamic flows. In order to determine if such an application was appropriate, we chose to conduct exacting habitat descriptions at the unique zones associated with peaking hydropower (degradation, aggradation, and recovery) and combine this information with suitability criteria for the banded sculpin (Cottus carolinae) and stage/discharge records to obtain weighted usable habitat estimates under typical peaking releases. The results demonstrate that habitat declines as the peaking surge passes an area and rises during low flow periods. However, there are difficulties in the interpretation of the results. That is, the biological response (lateral or longitudinal movement or entrainment) as well as the refuge value of certain hydraulic conditions remain to be investigated. This suggests that the present management value of IFIM applied to peaking hydropower is in examining minimum habitat values that occur during the generation cycle and a comparison of gains or losses in the minimum (greatest amount of hydraulic refuge available) weighted usable area estimates under various proposed release scenarios. (Author's abstract)
W89-11696

ASSESSING THE IMPACTS OF STREAM REGULATION IN THE FLATHEAD RIVER BASIN, MONTANA, U.S.A. I. SIMULATION MODELLING OF SYSTEM WATER BALANCE.
Montana Univ., Polson. Flathead Lake Biological Station.
For primary bibliographic entry see Field 4A.
W89-11698

EFFECT OF STREAM REGULATION ON THE PHYSICO-CHEMICAL PROPERTIES OF THE PALMIET RIVER, SOUTH AFRICA,
Cape Town Univ. (South Africa). Dept. of Zoology.
B. A. Byren, and B. R. Davies.
Regulated Rivers Research and Management RRRMEP, Vol. 3, No. 1-4, p 107-121, Jan-Apr 1989. 7 fig, 2 tab, 61 ref.

Descriptors: *Rivers, *Regulated flow, *Reservoir operation, *Dam effects, *Flow profiles, *South Africa, Physicochemical properties, Recovery distances, Temperature, Alkalinity, Hydrogen ion concentration, Nutrients, Invertebrates.

The effect of regulation, by multiple impoundment, on 'discontinuity (recovery) distances' for various physico-chemical attributes of the Palmiet River (a short, steep gradient, cool temperate, acid, low-nutrient system) was investigated. Physico-chemical features were measured monthly, from February 1986 to August 1987, at 11 sites along the river, with concentration on two zones: one below an upper-reach impoundment, Nuweberg Dam; and one below a middle-reach impoundment, Arieskraal Dam. Median total suspended solids, nitrates, nitrites, and ammonium all increased below both dams with varying levels of 'recovery'. Median spot temperatures, pH and alkalinity increased below Nuweberg, but decreased below Arieskrall Dam, whereas the converse was true for soluble reactive phosphate. Nuweberg had no effect on conductivity and total dissolved solids, while Arieskraal caused a slight decrease. The river remained well oxygenated down its length. Distinct seasonal variations were recorded for: flow rate, with flow reversal below Nuweberg and flow constancy below Arieskraal; temperature, with seasonal shifts and dampening of annual temperature range below both dams; alkalinity, with seasonal shifts below Arieskraal, and nitrites and nitrates, but not for any other attributes. At least partial recovery was noted in all cases, but in some instances, recovery was incomplete to the estuary. The implications of such alterations, for invertebrates, in terms of reduction in habitat diversity as well as for food supply must be considerable, and studies are currently under way to determine community structure and diversity. (Author's abstract)
W89-11701

BIOTIC AND ABIOTIC GRADIENTS IN A REGULATED HIGH ELEVATION ROCKY MOUNTAIN RIVER.
Colorado State Univ., Fort Collins. Dept. of Biology.
N. J. Voelz, and J. V. Ward.
Regulated Rivers Research and Management RRRMEP, Vol. 3, No. 1-4, p 143-152, Jan-Apr 1989. 7 fig, 1 tab, 36 ref.

Descriptors: *Environmental gradient, *Regulated flow, *Dam effects, *Mountain streams, *Rocky Mountains, River systems, Reservoirs, Colorado, Chemical properties, Physical properties, Temperature, Stream biota, Detritus, Benthos, Algae, River beds, Reservoir operation.

Samples were collected year-round over a one-year period at sites 250, 500, 1000, 2300, 5200, and 11,000 meters downstream from a hypolimnetic-release reservoir on the Blue River, Colorado, to examine biotic and abiotic gradients induced by river regulation. The impoundment had only minimal effects on river chemistry and chemical variables failed to exhibit discernible downstream patterns. The temperature regime was markedly altered by regulation and exhibited a distinct downstream recovery gradient. The progressive downstream increase in zoobenthos species diversity is attributed, in part, to the thermal recovery. The average size of mineral substratum particles was greater at sites nearest the dam although cobble and pebble predominated at all sites. A downstream decrease in bed stability was accompanied by decreased water clarity and increases in scour and ice action. These factors may have accounted for the higher standing crops of periphyton near the dam and a shift from filamentous chlorophytes to a predominance of diatoms with increasing distance downstream. The amount of leaf detritus in the substratum increased downstream. The abundance of shredders, zoobenthic species that feed on leaf detritus, tracked the downstream increase in coarse sedimentary detritus. Spatial patterns of organic seston within the study reach, influenced partly by sloughing of periphyton, are thought to account for the downstream species replacement patterns exhibited within the filter-feeder guild. (Author's abstract)
W89-11704

EFFECTS OF AN UPLAND IMPOUNDMENT ON STRUCTURAL AND FUNCTIONAL PROPERTIES OF A SMALL STREAM IN A BASALTIC PLATEAU (GOLAN HEIGHTS, ISRAEL).
Tel-Aviv Univ. (Israel). Inst. for Nature Preservation Research.
K. Tuch, and A. Gasith.
Regulated Rivers Research and Management RRRMEP, Vol. 3, No. 1-4, p 153-167, Jan-Apr 1989. 6 fig, 3 tab, 37 ref.

Descriptors: *Dam effects, *Ecological effects, *Dam effects, *Reservoirs, *Environmental effects, *Israel, Golan Heights, Seasonal variation, Temperature, Turbidity, Invertebrates, Algae, Benthos.

The impact of an upland storage reservoir, typical of the series of reservoirs in the Golan Heights basaltic plateau, on structural and functional properties of the downstream ecosystem, in the vicinity of the reservoir, shortly after damming were evaluated. The effect of impoundment on water quality conditions may be divided into winter-spring, and summer periods. In winter-spring the impoundment seems to lengthen the period of flow of runoff quality water. This is evident by the elevated winter and spring turbidities and the higher concentrations of suspended solids below the reservoir. In summer, water quality below the reservoir is controlled by the consequences of stratification in the reservoir. The hypolimnial release results in depression of the maximal temperature and narrowing of the daily and seasonal temperature variations. It supplies water enriched in nutrients and low in oxygen, suspended solids and turbidity. The macroinvertebrate community responds to impoundment in density changes and a shifting of dominance. It is hypothesized that the thermal effect of hypolimnial release from warm monomictic reservoirs on the invertebrate community of warm streams will differ from an equivalent thermal change caused by cold dimictic reservoirs in cold, temperate zone, stream. The effect of impoundment on functional properties of the ecosystem are most pronounced. The rate of production of benthic algae biomass below the reservoir increased by more than two orders of magnitude, but the effect diminished downstream. The rate of processing of plant material below the reservoir was lower than above the reservoir. (Author's abstract)
W89-11705

SERIAL DISCONTINUITIES IN A ROCKY MOUNTAIN RIVER. I. DISTRIBUTION AND ABUNDANCE OF PLECOPTERA.
Montana Univ., Polson. Flathead Lake Biological Station.
J. A. Stanford, and J. V. Ward.
Regulated Rivers Research and Management RRRMEP, Vol. 3, No. 1-4, p 169-175, Jan-Apr 1989. 4 fig, 20 ref.

Descriptors: *Mountain streams, *Rocky Mountains, *Stream biota, *Dam effects, *Stoneflies, *Aquatic insects, *Colorado River, Hydrologic aspects, Headwaters, Regulated reaches, Aquatic populations, Distribution, Reservoirs, Dams, Biomass, Population density, Dam effects, Hypolimnion.

Samples were taken year-round at eleven sites along the altitudinal profile (2900-1400 m a.s.l.) of the Gunnison River, a 329 km tributary of the Colorado River, to document the distribution of the Plecoptera and to evaluate responses to hypolimnial-release dams in the headwaters and middle reaches. Twenty-two species were present, with the greatest species richness occurring in an unregulated segment upstream of the middle reach dams; average nymphal biomass over the study period (175 organisms, 395 mg dry mass/sq m) was also greatest in this segment. Only four species (58 organisms, 48 mg/sq m) were present in the tailwaters of the headwater dam and values were greatly reduced (nine species; 35 organisms, 180 mg/sq m) below the middle reach dams. The stonefly community recovered ca. 80 km downstream from the last dam (15 species; 244 organisms, 250 mg/sq m), apparently in response to natural resetting of environmental conditions corresponding to those above the middle reach dams. At the most downstream site only four species (four organisms, 16 mg/sq m) were present. The observed distributional pattern is a classic serial discontinuity in response to hypolimnial stream regulation in a temperate latitude river. (See also W89-11707) (Author's abstract)
W89-11706

SERIAL DISCONTINUITIES IN A ROCKY MOUNTAIN RIVER. II. DISTRIBUTION AND ABUNDANCE OF TRICHOPTERA.
Montana Univ., Polson. Flathead Lake Biological Station.
F. R. Hauer, J. A. Stanford, and J. V. Ward.
Regulated Rivers Research and Management RRRMEP, Vol. 3, No. 1-4, p 177-182, Jan-Apr 1989. 3 fig, 24 ref.

Descriptors: *Rocky Mountains, *Mountain streams, *Stream biota, *Dam effects, *Caddisflies, *Aquatic insects, *Colorado, Hydrologic aspects, Headwaters, Regulated reaches, Aquatic populations, Distribution, Reservoirs, Dams, Biomass, Regulated flow, Dam effects, Population density.

River regulation in the headwaters and middle reaches of the Gunnison River, Colorado, significantly altered distributions and abundances of Trichoptera fauna. Twenty-five species were collected from mainstream samples, with the greatest species richness occurring at an unregulated, rhithron segment above the central reach dams. At sites immediately below the three hypolimnial-release dams and a reregulation dam, species richness was reduced 35-90 per cent and abundance > 95 per cent. Net-spinning caddisflies were the dominant trichopterans at unregulated sites; Arctopsyche grandis in the upper reaches (218 organisms, 586 mg dry mass/sq m) and Hydropsyche cockerelli, H. occidentalis and Cheumatopsyche pettiti in the lower river (9041 total organisms, 6621 mg/sq m), downstream from the last dam. The observed distributional pattern of low trichopteran densities in dam tailwaters and high hydropsychid densities at sites 60-80 km below the central reach dams is a classic expression of continuum resets and adjustments in response to stream regulation as predicted by the Serial Discontinuity Concept. (See also W89-11706) (Author's abstract)
W89-11707

CHANGES IN BENTHIC ANIMAL PRODUCTION OF A WEIR BASIN AFTER EIGHT YEARS OF SUCCESSION.
Bergen Univ. (Norway). Zoological Museum.
A. Fjellheim, G. G. Raddum, and O. A. Schnell.
Regulated Rivers Research and Management RRRMEP, Vol. 3, No. 1-4, p 183-190, Jan-Apr 1989. 2 fig, 3 tab, 33 ref.

Descriptors: *Succession, *Productivity, *Dam effects, *Benthic fauna, *Weirs, *Stream biota, Aquatic animals, Midges, Mayflies, Norway, Aquatic populations, Dams, River regulation, Weir basin, Aquatic habitats.

Benthic animal production was studied in a weir basin area of western Norway in 1984, eleven years after construction of the basin and eight years after the first benthic study. Compared to estimates from 1976, a marked change in production and species composition had occurred. Benthic animal production (J/sq m/y) at two stations inside the basin was 199 and 169 KJ/sq m/y, an increase of 440 and 270 per cent respectively compared to 1976. In a riffle upstream of the basin, the production estimate was 50 KJ/sq m/y, a decrease of 40 per cent since 1976. Chironomids formed the main contribution to the increased production in the weir basin, mainly through increased abundance of larger species like Stictochironomus pictulus and Micropsectra spp. Also other species more adapted to lentic water, like the ephemeropterans Siphlonurus aestivalis and Ameletus inopinatus, showed increased density. The fauna succession and increased production in the weir basin was mainly due to improved habitats and food conditions, as the amount of organic sediments had increased since the first production study. (Author's abstract)
W89-11708

REVIEW OF THE EFFECT OF RIVER REGULATION ON MAYFLIES (EPHEMEROPTERA).
Oslo Univ. (Norway). Lab. for Freshwater Ecology and Inland Fisheries.
J. E. Brittain, and S. J. Saltveit.
Regulated Rivers Research and Management RRRMEP, Vol. 3, No. 1-4, p 191-204, Jan-Apr 1989. 2 fig, 1 tab, 117 ref.

Descriptors: *Dam effects, *Regulated flow, *Mayflies, Reservoirs, Aquatic insects, River flow, Dams, Life cycles, Temperature, Hydroelectric plants, Life cycles.

Impoundment and diversion of watercourses for power production and water supply can have profound effects on the mayfly fauna. To explain such effects a species-specific approach is adopted to account for differing habitat requirements and life histories within orders and even within genera. Environmental conditions such as discharge and flow patterns, temperature, food availability, and predation may be altered which leads to changes in the density and species composition of the mayfly community, especially when there is a hypolimnion drain from reservoirs. In addition, temperature changes below such reservoirs may prevent obligatory life cycle stages while prolonged periods of low discharge can lead to the dominance of genera, such as Paraleptophlebia, Choroterpes, Siphlonurus, and Pseudocloen, which are typical of slow-flowing and lentic habitats. The life cycle plasticity and opportunism shown by Baetis rhodani in Europe and B. tricaudatus in North America have undoubtedly contributed to their success in regulated rivers. The life history characteristics of tricorythodes are also advantageous below dams. The increased growth of periphyton and

mosses below many dams favor certain Ephemerellidae, but restrict or eliminate many Heptageniidae. In order to survive adverse conditions, flexible life cycles or a short period of rapid nymphal growth coupled with a long period of egg development are advantageous. (Author's abstract)
W89-11709

PREDICTION OF REGULATION EFFECTS ON NATURAL BIOLOGICAL RHYTHMS IN SOUTH-CENTRAL AFRICAN FRESHWATER FISH.
J.L.B. Smith Inst. of Ichthyology, Grahamstown (South Africa).
P.B.N. Jackson.
Regulated Rivers Research and Management RRRMEP, Vol. 3, No. 1-4, p 205-220, Jan-Apr 1989. 7 fig, 6 tab, 41 ref.

Descriptors: *Dam effects, *Biorhythms, *Reservior fisheries, *Africa, *Fish populations, *Reservoirs, Colonization, Species diversity, Life cycles, River regulation, Population dynamics.

Fish in south-central African freshwaters are governed by biological rhythms. First, these are associated with the markedly seasonal summer annual rainfall when breeding takes place with an initially high mortality among newspawned juveniles. Second, a longer term rhythm of annual rainfall variability occurs in cycles up to or more than a decade. These cause water levels to vary from exceptionally high levels to near desiccation in endorheic systems. Studies of the shallow endorheic lakes Mweru Wa'Ntipa (Zambia), Nhami (Botswana),and Chilwa (Malawi) are cited showing that species diversity rapidly increases by colonization from adjacent 'inocula' (relict communities surviving in more permanent nearby water bodies, e.g. deep pools in perennial streams) when filling starts. During the drydown phase of the cycle, diversity decreases through lack of annual breeding environment and diminution of water quantity and quality. A few, usually three, species remain longer which, being physiologically hardy or showing phenotypic plasticity, are tolerant of higher salinity, temperature, etc., conditions associated with dry-out. Despite the lakes wide geographical separation these taxa in every case are a single species of the tilapia, genus Oreochromis, the catfish Clarias gariepinus, and the minnow Barbus paludinosus, which build up large populations valuable to local fisheries. Evidence from the Pongolo River, Zululand, regulated by a large dam, shows that fish of downstream endorheic lakes react similarly to artificial water deprivation, with mainly the same taxa persisting. Managed water releases timed to coincide with breeding rhythms largely restore the conditions which previously prevailed. Data form Zambezi impoundments indicate conversely that reaction of previously riverine fish to large man-made lakes is for previously sparse lentic taxa like Oreochromis to proliferate greatly while lotic forms like Labeo are reduced in number. (Author's abstract)
W89-11710

STUDY OF PHYSICAL PARAMETERS AT THE SPAWNING SITES OF THE EUROPEAN GRAYLING (THYMALLUS THYMALLUS L.),
Fiskeristyrelsen, Haernoesand (Sweden). Regional Office.
For primary bibliographic entry see Field 2H.
W89-11711

EFFECTS OF STREAM REGULATION ON ATLANTIC SALMON, SALMO SALAR L., AND BROWN TROUT, SALMO TRUTTA L., IN THE UPPER SEVERN CATCHMENT, U.K.
Humberside Coll. of Higher Education, Grimsby (England).
I. G. Cowx, and R. A. Gould.
Regulated Rivers Research and Management RRRMEP, Vol. 3, No. 1-4, p 235-245, Jan-Apr 1989. 5 fig, 6 tab, 18 ref.

Descriptors: *Ecological effects, *River basins, *Dam effects, *Wales, *Fish populations, *Salmon, *Trout, *Regulated flow, Temperature, Densities.

Data for three rivers in the upper Severn catchment were examined to assess the influence of regulation strategies on the Atlantic salmon and brown trout populations. Fisheries data for the two regulated rivers, Afon Clywedog and Afon Vyrnwy were compared with similar data from an adjacent, unregulated river, the Afon Dulas. In a stable, self-maintaining fish population, the abundance of each age-class typically declines with increasing age. Also at high densities, recruitment and survival of Atlantic salmon and brown trout have been shown to be negatively density-dependent, particularly during their first year of life. In the regulated rivers the seasonal and diel temperature regimes were markedly influenced by the release discharge and the depth of withdrawal from the reservoir. The size of the juvenile recruitment in the Clywedog showed a progressive fall from year to year, until it was virtually negligible. This deterioration was undoubtedly caused by the necessity to substantially increase the utilization of Llyn Clywedog, as it was not evident in the non-regulated Dulas, and is therefore a function of flow regulation in the river. No apparent demise was observed in the fish populations of the Vyrnwy because the flow and temperature characteristics were less variable and the influence of regulation was masked by water derived from elsewhere in the catchment. (White-Reimer-PTT)
W89-11713

EFFECTS OF RIVER REGULATION ON THE STRUCTURE OF A FAST-GROWING BROWN TROUT (SALMO TRUTTA L.) POPULATION.
Oslo Univ. (Norway). Zoological Museum.
P. Aass, P. S. Nielsen, and A. Brabrand.
Regulated Rivers Research and Management RRRMEP, Vol. 3, No. 1-4, p 255-266, Jan-Apr 1989. 6 fig, 6 tab, 11 ref.

Descriptors: *Dam effects, *Population dynamics, *Norway, *Trout, *Regulated flow, *Fish populations, Forage fish, Smelt, Vendace, Spawning, Growth, Hydroelectric plants.

During the last 70 years, the Norwegian lake Mjosa and its inflowing rivers have been subjected to serious changes due to hydroelectric power development. Regulation of the main inlet river, Gudbrandsdalslagen, started in 1919. The river power station at the Hunder fall was completed in 1964. This resulted in a reduction of winter water flow below the Hunder dam from approximately 26 cu m/s, which affected the most important spawning area of the fast-growing population of brown trout, Salmo trutta L. The population was investigated in detail in 1907, 1909, 1961, and 1985, and river growth, smolt age, and growth in Lake Mjosa are compared. Only wild fish were included in the study. The main pattern throughout this period shows an increased river growth rate before smoltification and reduced smolt age. The average smolt age dropped from 4.7 years in 1909 to 4.1 years in 1985, and at the same time smolt size decreased from 26.8 cm to 25.1 cm. Considering the major changes in abiotic factors in the river spawning section, the changes in age structure and growth of brown trout smolt are comparatively small. In Lake Mjosa, increased productivity due to input of nutrients has obviously favored forage fish such as smelt (Osmerus eperlanus (L.)) and vendace (Coregonus albula (L.)). The growth rate of brown trout in the lake has improved from 1909 to 1961 and 1985, followed by a reduced spawning age. However, due to increased human exploitation the average length of ascending fish (approximately 68 cm) and condition factor (K = 1.14-1.16) have altered little. (Author's abstract)
W89-11715

EFFECTS OF RIVER REGULATION ON THE LOWER EBRO RIVER (NE SPAIN).
Barcelona Univ. (Spain). Dept. de Ecologia.
I. Munoz, and N. Prat.
Regulated Rivers Research and Management RRRMEP, Vol. 3, No. 1-4, p 345-354, Jan-Apr 1989. 5 fig, 3 tab, 18 ref. Grant of CAYCIT no AC 16/84.

Descriptors: *Dam effects, *Streamflow, *Regulated flow, *Spain, *Stream discharge, Organic matter, Nutrients, Algae, Particulate matter, Food habits, Productivity, Conductivity.

The regulation of the Ebro River in the 1960s has changed the discharge pattern: spring floods have been reduced and, as the reservoirs are used for hydroelectrical purposes, discharge varies daily. These changes in flow regime have resulted in changes in water quality. In addition, most of the summer flow is diverted through two channels for rice field irrigation. As a result the last 20 km of the river are more similar to an elongated estuary, with saline intrusion. The last 50 km of the river have been studied for two years (1986 and 1987). The main purpose was to establish the particulate organic and inorganic transport of the river and its seasonal changes by sampling particulate matter in surface and deep waters. Water conductivity ranges between 0.9 and 53 mS, and anoxia is common in summer. Particulate C ranges between 1 and 3 mg/L with higher values in summer; particulate N is very similar along the year with values between 0.1 and 0.5 mg/L. River regulation seems to be important in supplying very high nutrient concentrations to algae which results in a high biomass and productivity in the lower part of the river, especially in summer. Diatoms and Chlorophyta are the most abundant groups. Phosphorus is higher than 5 micromol/L, with lower values in summer. Most of the particulate material is very fine (between 0.45 and 50 microm). The high biomass also explains the abundance of filter-feeders, such as Hydropsyche and Ephoron virgo. In areas where light reaches the bottom and stones and boulders are covered by Cladophora, grazers such as the gastropods Melanopsis and Theodoxus are abundant. (Author's abstract)
W89-11722

REVIEW OF THE SCHISTOSOMIASIS RISK IN SOUTH AFRICAN DAMS,
Research Inst. for Diseases in a Tropical Environment, Nelspruit (South Africa).
S. J. Pretorius, P. H. Joubert, and K. N. de Kock.
Water SA WASADV, Vol. 15, No. 2, p 133-136, April 1989. 1 fig, 2 tab, 12 ref.

Descriptors: *Dam effects, *Risk assessment, *South Africa, *Human diseases, *Schistosomiasis, *Reservoirs, *Public health, *Parasites, Survey, Snails, Data collections, Spatial distribution, Biogeography, Endemism.

Information obtained from the data base of the former Snail Research Unit of the South African Medical Research Council at the University of Potchefstroom and the Atlas of Bilharzia was used to evaluate the risk of contracting schistosomiasis in South African dams (reservoirs). The results indicated that almost all dams in the schistosomiasis endemic area contained snails belonging either to the Bulinus africanus group, the intermediate hosts of Schistosoma haematobium, and/or Biomphalaria pfeifferi (intermediate host of S. mansoni). Dams in this area have the potential for schistosomiasis transmission and consideration should be given to introducing snail control measures. Bulinus africanus species group occurred sporadically in dams in areas bordering the endemic regions; therefore snail and parasite surveys should be conducted periodically to monitor possible changes in distribution. At present dams in the rest of the country do not pose any risk of schistosomiasis infection because the intermediate host snails do not occur in them. (Author's abstract)
W89-11749

PHYSICAL HABITAT USE BY LOACH MINNOW, TIAROGA COBITIS (PISCES: CYPRINIDAE), IN SOUTHWESTERN DESERT STREAMS.
Rocky Mountain Forest and Range Experiment Station, Tempe, AZ. Forestry Sciences Lab.
J. N. Rinne.
Southwestern Naturalist SWNAAB, Vol. 34, No. 1, p 109-117, March 1989. 4 fig, 1 tab, 14 ref.

Descriptors: *Stream biota, *Deserts, *Fish behavior, *Endangered species, *Aquatic habitats, Min-

nows, Riffles, Growth stages, Adaptation, Dam effects, Ecological effects.

Physical habitats by loach minnow, Tiaroga cobitis, in streams are contrasted and compared in three areas. Because of the threatened or endangered status of the species and the lack of specific information on its habitat requirements, a study was initiated to quantify physical habitat use by loach minnow in Aravaipa Creek, Arizona. Comparative habitat data were also collected in several larger streams on the northern fringes of the Chihuahuan Desert in the upper Gila River Basin, New Mexico. The loach minnow is an obligate riffle-dwelling fish that inhabits shallow (<20 cm) water with currents 30 to 40 cm/s over gravel to cobble (16 to 256 mm) substrate. Habitat (velocity, depth, substrate) used varied with stream size and habitat availability and appeared to be related to both fish size and the individual fish's response to current. Adults (>38 m total length) occupied habitat different from larvae (<28 mm total length) but not different from juveniles (29 to 37 mm total length). Data suggests that, although the loach minnow is widely adapted to physical habitat. This highly-specialized fish has become markedly reduced in range because of habitat loss by dams, water diversion, and introduction of nonnavtive fishes. (Miller-PTT)
W89-11810

WATER-QUALITY ASSESSMENT USING AQUATIC MACROINVERTEBRATES FROM STREAMS OF THE LONG PINE CREEK WATERSHED IN BROWN COUNTY, NEBRASKA,
Nebraska State Dept. of Environmental Control, Lincoln. Water Quality Div.
T. R. Maret.
Transactions of the Nebraska Academy of Sciences and Affiliated Societies TNASDJ, Vol. 16, p 69-84, 1988. 6 fig, 6 tab, 32 ref.

Descriptors: *Stream biota, *Bioindicators, *Water pollution effects, *Environmental impact, *Land use, *Nebraska, *Water quality, *Macroinvertebrates, Species composition, Population density, Species diversity, Impaired water quality.

The macroinvertebrate communities of Long Pine and Bone creeks, Nebraska were assessed between July 1979 and October, 1982, as part of a water-quality monitoring program of the Long Pine watershed. At least 125 and 90 taxa were collected from Long Pine and Bone creeks, respectively. Data were summarized for the six collection sites by density, taxonomic composition, and species diversity. A biotic index, modified for Nebraska waters, was used to describe the biological integrity of streams sampled. The findings are discussed in relation to observed water-quality degradation and land-use practices. The biological community shows a slight degradation in water quality at the downstream stations on both Long Pine and Bone creeks. Both Bone Creek stations showed large fluctuations in diversity and species composition and, at times, exhibited stressed aquatic faunas. Surber samples showed no values in the EXCELLENT range for Long Pine stations, as expected. Refinement of tolerance values resulting from better taxonomic resolution is needed to develop a more sensitive tool to identify high quality as well as impaired waters. Until this refinement is achieved, collections containing large numbers of facultative organisms must be assessed with caution. Community indices used showed variability due to seasonal changes and habitat preferences. This indicates the importance of using other assessment methods in conjunction with these indices to effectively evaluate water quality. Analysis showed a slight trend of impaired water quality from headwaters to downstream monitoring stations. The results represent the first documented collections of macroinvertebrates from these waters, and serve as baseline information to document trends in water quality. (Miller-PTT)
W89-11821

ENVIRONMENTAL ASSESSMENT OF SUBSURFACE DISPOSAL OF MUNICIPAL WASTEWATER TREATMENT SLUDGE: INTERIM REPORT.

For primary bibliographic entry see Field 5E.
W89-11885

DOLORES ARCHAEOLOGICAL PROGRAM: ACERAMIC AND LATE OCCUPATIONS AT DOLORES.
Dolores Archaeological Program, CO.
G. T. Gross, and A. E. Kane.
Available from the National Technical Information Service, Springfield, VA 22161. October 1988. 418p, 213 fig, 61 tab, 405 ref, 23 append. Bureau of Reclamation Contract 8-07-40-S0562.

Descriptors: *Archaeology, *Water resources development, History, Social aspects, Dolores Archeological Program, Colorado.

The area to be impacted by the Dolores Project, a large water storage and distribution system in southwestern Colorado, was intensively occupied during the Basketmaker III and Pueblo I periods (approximately A.D. 600 to 900). Although the efforts of the Dolores Archaeological Program to mitigate the loss of archaeological resources in the area have focused on sites associated with the main occupations, sites belonging to periods other than those of the densest occupation have been investigated as well. Sites not fitting the pattern of the main occupations in the project area are characterized by a lack of ceramics, by evidence of having been occupied after the main occupation at Dolores, or by both of these attributes. Where ceramics are present on such sites they are of types known to postdate the Pueblo I period, or they represent an additional occupation of the site. Aspects of the Dolores Archaeological Program systematics area introduced. The spatial series, the site classification series, and the chronological series are briefly discussed. The prehistory of the Dolores Project area is summarized so the periods represented by the aceramic and late sites discussed can be understood in proper context. (Author's abstract)
W89-12091

MONITORING BIRD POPULATION DENSITIES ALONG THE COLORADO RIVER IN GRAND CANYON: 1987 BREEDING SEASON.
Glen Canyon Environmental Studies, Flagstaff, AZ.
B. T. Brown.
Available from the National Technical Information Service, Springfield, VA 22161, as PB89-103311. Price codes: A03 in paper copy, A01 in microfiche. Report No. GCES/25-87, September 15, 1988. 26p, 1 fig, 3 tab, 18 ref, 8 append. Bureau of Reclamation Contract IA-4-AA-40-01930.

Descriptors: *Population density, *Birds, *Water resources development, *Environmental effects, *Colorado River, *Ecology, Environment, Population dynamics, Dam effects.

The purpose of this study was to document the density of breeding birds in the Colorado River corridor in 1987 and to compare present avian abundance to available historical information. Two complementary types of breeding bird density were calculated: the site census (avian density per unit area for all species at ten paired study sites) and downriver census (indirect count of five indicator species throughout the river corridor). Breeding bird density at established study sites showed a significant trend of decline from 1984 to 1987. In contrast, population sizes of three indicator species (Willow Flycatcher, Yellow Warbler, and Yellow-breasted Chat) showed significant trends of increase from 1976 to 1987. Common Yellowthroats exhibited decline in population size in 1987 and have become one of the rarest breeding birds of the river corridor. National research is needed to establish the indirect, long-term links between Glen Canyon Dam operations and density and ecology of breeding birds. Monitoring bird populations gives useful short-term, direct response of species to dam operations and serve as a general barometer of ecological health of breeding birds. (Author's abstract)
W89-12097

REPORT ON THE SPRING 1988 REVIEW OF BURIAL SITES IN LAKE ROOSEVELT, FERRY, LINCOLN, AND STEVENS COUNTIES, WASHINGTON,
Eastern Washington Univ., Cheney. Archaeological and Historical Services.
R. A. Masten, and S. A. C. Keller.
Short Report Number SR-158, 1988. 34p, 5 fig, 17 ref, 2 append.

Descriptors: *Reservoirs, *Archaeology, *Washington, *Water resources development, Lake Roosevelt, Drawdown, History, Social aspects.

The drawdown of Lake Roosevelt, Washington during the spring of 1988 enabled a professional review of 32 of 43 burial sites and/or sites with burial components located along the reservoir. The purpose of this review was to identify those sites impacted by the reservoir, and to undertake emergency recovery of exposed skeletal materials or disturbed burials as appropriate prior to further loss of these features. Even with the approximately 50 ft (15 m) drop in the normal level of the pool and exposure of the shoreline, nine of these sites were found to remain inundated and could not be inspected during this project. A tenth site, 45ST203, located near the Old Kettle Falls townsite, also was not inspected. Site 45ST203 has been documented as destroyed and inundated and no further work is recommended for this area. The remaining site not encompassed by this project was 45ST74 and it was inaccessible due to logistical problems. Its condition is unknown and this area should be reviewed at the next possible opportunity. At a minimum, periodic inspections have been recommended for the remaining sites. Two sites, 45ST21 and 45FE1, yielded disturbed skeletal remains and are considered to be particularly sensitive to the effects of erosion and other reservoir-induced impacts. In additions, all sites containing oval-shaped piles of cobble mounds are assessed as sensitive and until such information is ascertained as to whether these piles are burials or served some other function, they should be monitored (see discussion for site 45ST44). Previous data recovery excavations along Lake Roosevelt have indicated that these features are often 'burial cairns' or 'burial mounds'. While these features appear relatively stable under current reservoir operations, they are considered to be susceptible to vandalism and relic collections when exposed. Locales exhibiting probable burial features include 45ST65, 45ST44, 45FE16, 45FE29, 45FE34, and 45ST16. These sites, in addition to 45ST21 and 45FE1, are recommended for review on a regular basis. (Author's abstract)
W89-12133

HOHOKAM SETTLEMENT ALONG THE SLOPES OF THE PICACHO MOUNTAINS VOLUME 6: SYNTHESIS AND CONCLUSIONS.
Museum of Northern Arizona, Inc., Flagstaff. Dept. of Anthropology.
R. Ciolek-Torrello, and D. R. Wilcox.
Museum of Northern Arizona Research Paper 35, 1988. 379p, 47 fig, 54 tab, 91 ref, append.

Descriptors: *Water resources, *Aqueducts, *Archaeology, Hohokam Indians, Picacho Mountains, Arizona, History, Social aspects, Agriculture, Irrigation, Water resources development.

This is the sixth and final volume in the series presenting the results of archaeological investigations of Hohokam sites along Reaches 1 and 2 of the Tucson Aqueduct, Phase A, Project. The project involved the investigation of two prehistoric platform mound communities in the Picacho Mountains area, which prior to these investigations were virtually unknown. The project focused on the Brady Wash community with lesser efforts in the Picacho community. The research efforts represented by the project documented the existence of an atypical Hohokam culture exploiting an arid and marginal environment where traditional Hohokam irrigation practices were not possible and a greater dependence on the gathering of wild plants was necessary for existence. Despite the markedly different subsistence strategies of the Hohokam populations of the Picacho Mountains area, they were clearly well integrated in the Classic period

Hohokam regional system and were able to survive in this inhospitable environment longer than in other areas more amenable to large-scale sedentary settlement. In fact, settlement of the Picacho Mountains area may have persisted for some time after the collapse of the regional system. The volume recounts the research and management histories of the project, and summarizes and synthesizes specific research topics documented separately in previous volumes. The result of all the archaeological research effort are placed in perspective in the concluding chapters and the major research questions originally presented in the research design (Volume I) are addressed along with those that emerged in the course of the project. (See also W87-07704, W89-01781, W89-01782, W88-05743, W88-06585, and W89-01803) (Author's abstract)
W89-12139

DOLORES ARCHAEOLOGICAL PROGRAM: ANASAZI COMMUNITIES AT DOLORES: GRASS MESA VILLAGE.
Dolores Archaeological Program, CO.
W. D. Lipe, J. N. Morris, and T. A. Kohler.
Available from the National Technical Information Service, Springfield, VA 22161 as PB89-131429, Price codes: E99 in paper copy, E08 in microfiche. June 1988. 1316p, 477 fig, 428 tab, 418 ref, 2 append. Bureau of Reclamation Contract 8-07-40-S0562.

Descriptors: *Water resources development, *Dam construction, *Archaeology, Dolores Archeological Program, Colorado, Anasazi Indians, Grass Mesa Village, History, Social aspects, Irrigation, Dating, Human population, On-site investigations.

Grass Mesa Village (5MT23) is located in the Dolores River canyon at the junction of Beaver Creek and the Dolores River, less than 1 km upstream from McPhee Dam, which will provide water for an expanded irrigation system in the Montezuma Valley and adjacent parts of southwestern Colorado. Fieldwork consisted of an intensive surface collection, a magnetometer survey, a probability sample of test pits, extensive exploratory trenching, and intensive block excavations. Work was done in the 1979, 1980, 1982, and 1983 field seasons by Washington State University, under a subcontract from the University of Colorado, as part of the Dolores Archaeological Program. Fieldwork results are reported for the 8 areas into which the site was subdivided for administrative and sampling purposes. The volume includes chapters on surface investigations, the probability sample, geoarchaeology, artifact analysis, faunal and floral remains, an economic intensification model, and a review of the chronology and distribution of structures and synthesis of the evidence of population and economy. Although Grass Mesa may have been occupied as early as A.D. 720, the principal early occupation was between about A.D. 750 and 825, and spanned the late Sagehill and early Dos Casas Subphases of the Sagehen Phase. After a period of low population or abandonment, several Periman Subphase roomblock units were built in the A.D. 850's or 860's. Some Periman structures continued to be occupied for a time after A.D. 880, and were contemporaneous with a new type of settlement used to define a new subdivision-the Grass Mesa Subphase. This subphase is represented by numerous, very small pitstructures, some of which were associated with surface roomsuites. The Grass Mesa Subphase occupation appears to have been brief, and the site was probably abandoned by A.D. 895 or 900, and certainly by A.D. 910. (Lantz-PTT)
W89-12140

DREDGING: BIOLOGICAL EFFECTS, JANUARY 1979-FEBRUARY 1988: CITATIONS FROM THE NTIS BIBLIOGRAPHIC DATABASE.
National Technical Information Service, Springfield, VA.
Available from National Technical Information Service, Springfield, VA 22161 as PB88-859186, Price codes: N01 in paper copy, N01 in microfiche. March 1988. 106p. Supersedes PB86-865839.

Descriptors: *Dredging, *Spoil banks, *Bibliographies, *Water pollution effects, Ocean dumping, Bioaccumulation, Waste disposal.

This bibliography contains citations concerning habitat degradation and development due to dredging operations and disposal. Topics include environmental impact studies, long-term effects, aquatic ecosystem response studies, and bioaccumulation of materials contained in dredge spoils. Ocean disposal operations, and studies performed in specific areas are also discussed. This updated bibliography contains 286 citations of which 60 are new entries to the previous edition. (Author's abstract)
W89-12160

7. RESOURCES DATA

7A. Network Design

MONITORING STRATEGIES TO DETERMINE COMPLIANCE WITH WATER QUALITY OBJECTIVES.
Inland Waters Directorate, Vancouver (British Columbia). Water Quality Branch.
D. Valiela, and P. H. Whitfield.
Water Resources Bulletin WARBAQ, Vol. 25, No. 1, p 63-69, February 1989. 6 fig, 12 ref.

Descriptors: *Monitoring, *Sampling strategies, *Water quality monitoring, *Water sampling, *Compliance, Data acquisition.

Two sampling strategies designed to test for compliance with water quality objectives are examined. For objectives based on long-term mean requirements, fixed frequency sampling at frequent intervals is most advantageous regardless of the underlying distribution of the data. For objectives that are based on maximum allowable concentrations, effective sampling strategies increase the likelihood of detecting noncompliance. If data are highly autocorrelated or sharply seasonal in distribution, an exceedance-driven sampling strategy is more effective and efficient for detecting violations than fixed frequency sampling. However, data generated by exceedance-driven sampling provide biased estimates of mean and standard deviation. (Author's abstract)
W89-11161

OPTIMUM EXPERIMENTAL DESIGN FOR PARAMETER IDENTIFICATION IN GROUNDWATER HYDROLOGY.
California Univ., Los Angeles. Dept. of Civil Engineering.
For primary bibliographic entry see Field 2F.
W89-11269

TERRAIN-BASED WATERSHED INFORMATION SYSTEM,
Toronto Univ. (Ontario). Dept. of Geography.
For primary bibliographic entry see Field 10D.
W89-11286

IMPORTANCE OF AGRICULTURAL WEATHER INFORMATION: A MICHIGAN SURVEY,
Michigan State Univ., East Lansing. Dept. of Entomology.
J. D. Carlson.
Bulletin of the American Meterological Society BAMIAT, Vol. 70, No. 4, p 366-380, April 1989. 7 fig, 3 tab, 14 ref, append. Agricultural Weather Service Contract NA85-WCC-06114.

Descriptors: *Weather, *Michigan, *Agriculture, Surveys, Forecasting, Air temperature, Precipitation, Humidity, Evaporation, Public relations.

A survey was conducted across Michigan in early 1986 in an attempt to better understand the needs of the agricultural community for weather information. The sample analyzed represented 318 respondents in agricultural professions. A smaller sample (227 respondents) representing four major groups of growers was also studied: field crops, fruit, vegetables, and livestock. The survey indicates the importance of accurate and timely agricultural weather information. A vast majority (88%) use such information on a daily basis, and most (71%) indicate potential annual savings in excess of $1000 through using such information. A variety of weather and weather-related variables were seen as important. Although some of the important variables, such as precipitation and air temperature, are included in public forecasts, many of them, such as degree days, humidity, and evaporation, are not. The existence of agricultural forecasts and advisories thus remains essential. Commercial radio and television are the two top current and preferred means of receiving agricultural weather information, but there is increasing desire to utilize such specialized modes as NOAA Weather Radio, telephone recordings, and computerized information-delivery systems. The overall message is that agricultural weather information is crucial and that every effort should be made to generate what is needed and then to disseminate it in a timely and preferred manner. (Author's abstract)
W89-11454

LOW-FLOW FREQUENCY ANALYSIS USING PROBABILITY-PLOT CORRELATION COEFFICIENTS.
Tufts Univ., Medford, MA. Dept. of Civil Engineering.
For primary bibliographic entry see Field 2E.
W89-11600

PARAMETER ESTIMATION FOR THE GENERAL EXTREME VALUE DISTRIBUTION.
Asian Inst. of Tech., Bangkok (Thailand).
For primary bibliographic entry see Field 7C.
W89-11742

EVALUATION OF METHODS FOR THE ESTIMATION OF TRIBUTARY MASS LOADS,
Notre Dame Univ., IN. Dept. of Civil Engineering.
For primary bibliographic entry see Field 5B.
W89-11777

SURFACE WATER TRACER INVESTIGATION OF LEACHATE DISCHARGE FROM A NEW YORK CITY LANDFILL.
New York State Dept. of Environmental Conservation, New York.
For primary bibliographic entry see Field 5B.
W89-11922

ABANDONMENT OF GROUNDWATER MONITORING WELLS AT THE SAVANNAH RIVER PLANT, AIKEN, SOUTH CAROLINA.
Du Pont de Nemours (E.I.) and Co., Aiken, SC. Savannah River Plant.
For primary bibliographic entry see Field 5G.
W89-11929

RAPID RISE OF SHALLOW GROUNDWATER TABLES ON INFILTRATION-PRELIMINARY RESULTS AND IMPLICATIONS ON AQUIFER CONTAMINATION.
Rutgers - The State Univ., New Brunswick, NJ.
For primary bibliographic entry see Field 2F.
W89-11935

HYDROGEOLOGIC MISINTERPRETATIONS AND AQUIFER CONTAMINATION CAUSED BY LEAKING MONITORING WELLS.
Brown (K.W.) and Associates, Inc., College Station, TX.
M. Trojan.
IN: HWHM 88: Hazardous Wastes and Hazardous Materials. Proceedings of the 5th National Conference held April 19-21, 1988, Las Vegas, Nevada. 1988. p 1-5, 5 fig, 9 ref.

Descriptors: *Monitoring, *Data interpretation, *Data acquisition, *Water pollution sources, *Groundwater pollution, *Geohydrology, *Aquifers, *Path of pollutants, Water pollution prevention, Wells, Groundwater recharge, Precipitation, Tracers, Drilling.

Well leakage often can be attributed to disturbance of brittle clay-rich geologic materials during well drilling. As the drill bit, cable tool chisel or auger penetrate the soil, a network of interconnected fractures can develop around the borehole, creating a transmissive passage through an aquitard between two aquifers or between the surface and an aquifer. Consequently, groundwater and contaminants can migrate around the well seals with relative ease. Four documented field cases at Resource Conservation and Recovery Act sites are presented that identify geohydrologic misinterpretations and groundwater contamination resulting from leaking monitoring wells. Due to the inability to examine specimens of the fractured materials, it is virtually impossible to verify disturbance in the vicinity of the borehole; however, it is possible to document well leakage by conducting simple tracer studies, pump tests, recharge tests, precipitation/well response tests and/or chemical time-series sampling. To minimize the potential for leakage around wells or through a grouted exploratory borehole, it is essential to select the appropriate drilling method and annular sealants and to properly place the seals. (See also W89-12002) (Author's abstract)
W89-12003

STRATEGIES FOR EXTERNAL LEAD DETECTION OF UNDERGROUND STORAGE TANKS.
Environmental Monitoring and Support Lab., Las Vegas, NV.
P. Durgin, J. Worlund, and J. D'Lugosz.
IN: HWHM 88: Hazardous Wastes and Hazardous Materials. Proceedings of the 5th National Conference held April 19-21, 1988, Las Vegas, Nevada. 1988. p 343-346, 2 fig, 1 tab, 2 ref.

Descriptors: *Network design, *Monitoring, *Groundwater pollution, *Underground storage, *Waste disposal, *Water pollution prevention, Risk assessment, Standards, Sensitivity analysis, Leakage.

State and federal regulations promote external monitoring primarily of vapor and floating product on the groundwater table around underground storage tanks (USTs). A site and risk assessment should be made at each location to help design a monitoring system plan. The site assessment should take risk factors into account both on-site and off-site. Risk is semi-quantitative measure of two things: the chance, and the consequence of a leak. A simple risk assessment would consider the likelihood of a leak and the cleanup cost. Data collection and analysis are the most important steps and should vary according to the assessed risk at a site. Some general guidelines are that monitoring techniques with greater sensitivity should be used at higher risk sites, remembering that increased sensitivity can result in more false positives. Additional, independent tests can decrease false negatives and reduce potential liabilities at higher risk sites. A series of steps should be taken to confirm a leak once an alarm goes off. (See also W89-12002) (Lantz-PTT)
W89-12047

GROUNDWATER QUALITY MONITORING IN A RISK ASSESSMENT FRAMEWORK.
Environmental Monitoring and Support Lab., Las Vegas, NV.
For primary bibliographic entry see Field 5A.
W89-12057

U.S. EPA FIELD ANALYTICAL SCREENING PROJECT,
Ecology and Environment, Inc., Arlington, VA.
G. H. Chapman, and S. Fredericks.
IN: HWHM 88: Hazardous Wastes and Hazardous Materials. Proceedings of the 5th National Conference held April 19-21, 1988, Las Vegas, Nevada. 1988. p 415-417.

Descriptors: *Hazardous wastes, *Disposal sites, *Network design, *Pollutant identification, *Data acquisition, *Project planning, Path of pollutants, Surveys, Evaluation, Field Analytical Screening Project.

In response to the concerns raised by Congress and the public, EPA is evaluating means of improving characterization of hazardous waste sites through enhancing on-site analytical capabilities for the investigation of hazardous waste sites. The Field Analytical Screening Project (FASP) has been established in an effort to address these concerns. FASP will be used to generate quick turnaround screening data where rigorously qualified data are not required. It is designed to provide screening data for specific compounds known to be on the site from previous data. FASP will be used mainly during Listing Site Investigations (LSIs) to help determine the extent of contamination and to choose samples to document a contaminant release for the Hazard Ranking System (HRS). The nationally coordinated FASP program includes the following: analytical methods; safety procedures; personnel training; analytical instrumentation; and data quality objectives. A Base Support Facility (BSF) is located in each region to serve as a staging area for all field activities. A support vehicle is equipped to perform screening for target compounds on-site. Instrumentation will be stored at the base support facility and transferred to the support vehicle as need for specific sites. (See also W89-12002) (Lantz-PTT)
W89-12058

CONCEPTUAL DESIGN FOR THE NATIONAL WATER INFORMATION SYSTEM.
M. D. Edwards, A. L. Putnam, and N. E. Hutchison.
Available from Books and Open-File Report Section, USGS, Box 25425, Denver, CO 80225. U.S. Geological Survey Bulletin 1792, 1987. 22p, 7 fig, 1 tab, 3 ref.

Descriptors: *Water resources data, *Hydrologic data, *Information systems, *Information exchange, *Data storage and retrieval, Computer programs, Water resources development, Water use.

The Water Resources Division (WRD) of the U.S. Geological Survey began to design and develop a National Water Information System (NWIS) in 1983. The NWIS will replace and integrate the existing data systems of the National Water-Data Storage and Retrieval System, National Water-Data Exchange, National Water-Use Information Program, and Water Resources Scientific Information Center. The NWIS is planned as an interactive, distributed data system. The software has been designed as a modular structure that integrates existing functions and allows multiple use of the various facilities. The data base incorporates a relational data model that allows integrated storage of the existing water data, water-use data, and water data-indexing information within a common relational database management system. The NWIS will be operated on microcomputers located in each of the WRD's district offices and in many of its State, subdistrict, and field offices; these microcomputers will be linked together through a national telecommunication network maintained by the U.S. Geological Survey. The NWIS is scheduled to go online in 1990. (Author's abstract)
W89-12126

7B. Data Acquisition

BIOCHEMICAL METHODS FOR AUTOMATED BACTERIAL IDENTIFICATION AND TESTING METABOLIC ACTIVITIES IN WATER AND WASTEWATER.
Technische Univ. Berlin (Germany, F.R.). Dept. of Hygiene.
W. Dott, and P. Kampfer.
Water Science and Technology WSTED4, Vol. 20, No. 11/12, p 221-227, 1988. 3 fig, 3 tab, 11 ref.

Descriptors: *Biochemical tests, *Automation, *Bacterial analysis, *Metabolism, Pollutant identification, Biochemistry, Anaerobic bacteria, Aerobic bacteria, Microenvironment, Aquatic environment, Wastewater, Photometry, Computers, Heterotrophic bacteria, Bacterial physiology, Population diversity.

The improvements of computer-assisted identification were used to develop a new microplate system for characterization and identification of various gram-negative and gram-positive heterotrophic bacteria from the environment. In standard microtitration plates, about 90 biochemical tests, some conventional, carbon substrate assimilation and enzyme tests using chromogenic substrates can be performed. Reading of the test results is done automatically by a photometer coupled to a computer. The applications of this identification system are shown by two wastewater samples from the treatment plant at Berlin-Ruhleben, West Germany. A total of 48 organisms were isolated and identified, including an array of gram-negative facultative anaerobic bacteria, gram-negative aerobic bacteria, gram-positive endosporeforming bacteria, and irregular nonsporing gram-positive bacteria. This coupling of photometer with computer allows (1) identification of aerobic, heterotrophic environmental organisms, (2) study of the physiological activities of the test organisms (degradation of different organic carbon sources, production of extracellular enzymes), (3) description of the populations and their diversity, (4) measurement of activities of crude samples and mixed bacterial cultures, (5) judgment of microhabitats (leading to environmental pollutants/toxic substances through decrease in bacterial numbers or specific microbial activities), and (6) control of the populations during microbial processes and changes in microbial activities. (Friedmann-PTT)
W89-11100

PHENOTYPE VARIATION WITHIN KLEBSIELLA PNEUMONIAE: A TOOL TO TRACE SOURCES OF CONTAMINATION IN SURFACE WATER.
National Bacteriological Lab., Stockholm (Sweden).
For primary bibliographic entry see Field 5A.
W89-11129

PRECIPITATION CATCH MEASURED BY THE WYOMING SHIELD AND THE DUAL-GAGE SYSTEM.
Agricultural Research Service, Boise, ID. Northwest Watershed Research Center.
C. L. Hanson.
Water Resources Bulletin WARBAQ, Vol. 25, No. 1, p 159-164, February 1989. 1 fig, 2 tab, 24 ref.

Descriptors: *Measuring instruments, *Rain gages, *Precipitation, Snowfall, Wyoming shield, Air temperature, Reynolds Creekr Experimental Watershed, Idaho.

The Wyoming shield and dual-gage measuring systems were developed to measure all precipitation, but more specifically snowfall under windy conditions. Results of a study at 5 sites on the Reynolds Creek Experimental Watershed in southwest Idaho indicate that gages with Wyoming shields and the dual-gage system measured the same amount when air temperature were higher than -2.2 C. Precipitation amounts computed from the dual-gage system were slightly more than from gages with Wyoming shields for snowfall, especially under windy conditions. Results also show how well the Alter shielded and unshielded gages used in the dual-gage system represent the computed catch if data were only available from one or the other of the gages. (Author's abstract)
W89-11172

SUBMERSIBLE-DEPLOYED VIDEO SEDIMENT-PROFILE CAMERA SYSTEM FOR BENTHIC STUDIES.
Wisconsin Univ.-Milwaukee. Center for Great Lakes Studies.
L. F. Boyer, and J. Hendrick.
Journal of Great Lakes Research JGLRDE, Vol. 15, No. 1, p 34-45, 1989. 6 fig, 1 tab, 34 ref. Federal Grant NA8YAA-D-0065, Project R/MW-38-PD.

Descriptors: *Cameras, *Instrumentation, *Limnology, *Lake sediments, *Bottom sediments, *Lake Superior, *Sediment-water interfaces, *Sub-

marines, Video cameras, Sedimentary structures, Great Lakes.

A low-resolution, charge-couple-display video sediment-profile camera system was designed specifically for use with manned submersibles. It was successfully deployed as a prototype for NOAA's NURP-UCAP Lake Superior Dive Project in the summer of 1985, modified, and deployed on four separate dives to 350 m in the Caribou Island basin area of Lake Superior in 1986. This system provides instantaneous in situ information on the sediment-water interface during recovery of tube cores and box cores, and enables deployment of in situ manipulative experiments in known sub-surface sediment conditions. Specifically, vertical and horizontal heterogeneity in sediment thickness, general bioturbational features, and major sedimentary structures were visible from primary imagery in real time, on scales from tens of centimeters to approximately 1 centimeter. Video acquisition, storage, data transfer, and resolution losses hamper the quantitative use of the present prototype. Four video images of the substrate are compared with 35-mm deck photos of sub-cores, 35-mm shipboard sediment-profile camera photos, and X-radiographs of box cores. This comparison confirms the position that a detailed view of the sediment-water interface and local benthic environs requires information from many complementary technologies. Future enhancements require higher video resolution, digital image acquisition, storage and transfer capability, and image analysis of the near-original video product. (Author's abstract)
W89-11184

WATER AND SURFACE ENERGY BALANCE MODEL WITH A MULTILAYER CANOPY REPRESENTATION FOR REMOTE SENSING PURPOSES.
National Aeronautics and Space Administration, Greenbelt, MD. Hydrological Sciences Branch.
A. A. van de Griend, and J. H. van Boxel.
Water Resources Research WRERAO, Vol. 25, No. 5, p 949-971, May 1989. 11 fig, 62 ref. Science Applications Research contract NAS5-28200.

Descriptors: *Canopy, *Energy, *Remote sensing, *Model studies, *Soil-water-plant relationships, Vegetation effects, Temperature gradient, Heat transfer, Heat budget, Physical properties, Thermal radiation, Energy.

A surface energy balance model with a multilayer canopy representation is developed to simulate the vertical temperature distribution of the foliage elements and the soil underneath. This model allows simulation of the radiative temperature of the complex vegetation-covered surface as a function of the angle of observation. The model was implemented for a two-layer canopy and has been tested by comparing simulated radiative surface temperatures (observed under a look angle of 45 degrees), latent heat, sensible heat, momentum, and ground heat fluxes, and soil temperatures at different depths, with observed data, gathered in a maize field. The fluxes above the canopy were measured by eddy correlation methods. The model structure and simulation results were compared with the field measurements. Except for the ground heat fluxes, all the simulated and measured parameters matched reasonably well. Further, the model was used to study the sensitivity of the radiative temperature of the complex surface to variations in the roughness length, the leaf area index, and the drag coefficient. The radiative surface temperature turned out to be very insensitive to variations in the leaf area index and drag coefficient, and it was found that resulting variations in the radiative surface temperature fall well within the detection error of the remotely sensed surface temperature. (Author's abstract)
W89-11263

EVALUATION OF GROUNDWATER REPLENISHMENT COEFFICIENTS FROM THE RECORD OF A BOREHOLE PENETRATING THE UNSATURATED ZONE.
Ministry of Agriculture, Jerusalem (Israel). Hydrological Service.
For primary bibliographic entry see Field 2F.
W89-11264

HYDRODYNAMIC DISPERSION AT THE LOCAL SCALE OF CONTINUUM REPRESENTATION.
Atomic Energy of Canada Ltd., Chalk River (Ontario). Chalk River Nuclear Labs.
For primary bibliographic entry see Field 5B.
W89-11270

BOUWER AND RICE SLUG TEST-AN UPDATE,
Agricultural Research Service, Phoenix, AZ. Water Conservation Lab.
H. Bouwer.
Ground Water GRWAAR, Vol. 27, No. 3, p 304-309, May-June 1989. 6 fig, 3 ref.

Descriptors: *Aquifer testing, *Pumping tests, *Hydraulic conductivity, *Boreholes, *Groundwater level, *Geohydrology, *Water level, Water table wells, Water table, Test wells, Aquifers, Observation wells.

The Bouwer and Rice slug test was developed to measure aquifer hydraulic conductivity around boreholes (production, monitoring, or test wells). The wells can be partially penetrating and partially screened, perforated, or otherwise open. The slug test can be based on quickly withdrawing a volume of water from the well and measuring the subsequent rate of rise of the water and measuring the subsequent rate of fall of the water level in the well, or by adding a slug of water and measuring the subsequent rate of fall of the water level in the well. While originally developed for unconfined aquifers, the method can also be used for confined or stratified aquifers if the top of the screen or perforated section is some distance below the upper confining layer. Anomalies ('double straight line effect') sometimes observed in the measured rate of rise of water level in the well are attributed to drainage of a gravel pack or developed zone around the well following lowering of the water level. The effect of this drainage can be eliminated by ignoring the early data points and using the second straight line portion in the data plot for calculation of hydraulic conductivity. The method is applicable to any diameter and depth of the borehole, provided that the dimensions of the system are covered by the ranges for which the geometry factor R sub e has been worked out. The smaller the diameter for the hole, however, the more vulnerable the results will be to aquifer heterogeneities and to inaccuracies in estimating effective well diameters. Time needed for calculating K, the hydraulic conductivity of the aquifer around a well, has been reduced by a computer program in which values for length of open section of well (L sub e) divided by radial distance of undisturbed portion of aquifer from centerline (r sub w) are stored for direct calculation of ln(R sub e/r sub w) and K from field data. (Friedmann-PTT)
W89-11272

STORAGE BASIN VOLUME AND DRAINAGE BASIN DYNAMICS: CAMAS PRAIRIE, SOUTH-CENTRAL IDAHO.
Northern Arizona Univ., Flagstaff. Dept. of Geology.
For primary bibliographic entry see Field 2F.
W89-11275

COMPARISON OF INSTRUMENTAL DEWATERING METHODS FOR THE SEPARATION AND CONCENTRATION OF SUSPENDED SEDIMENT FOR SUBSEQUENT TRACE ELEMENT ANALYSIS,
Geological Survey, Doraville, GA.
A. J. Horowitz, K. A. Elrick, and R. C. Hooper.
Hydrological Processes HYPRE3, Vol. 3, No. 2, p 163-184, April/June 1989. 6 fig, 16 tab, !9 ref.

Descriptors: *Water analysis, *Chemical analysis, *Dewatering, *Suspended load, *Filtration, *Trace elements, Pollutant identification, Comparison studies, Drying, Sediments, Particulate matter.

A comparison involving both field and laboratory trials was performed to evaluate the utility of two continuous-flow centrifuges and a tangential-flow filtration system for dewatering suspended sediments for subsequent trace element analysis. Although recovery efficiencies for the various devices differ, the analytical results from the separated suspended sediments indicate that any of the tested units can be used effectively and precisely for dewatering. Further, the three devices appear to concentrate and dewater suspended sediments in such a manner as to be equivalent to that which could be obtained by in-line filtration. Only the tangential-flow filtration system appears capable of providing both a dewatered sediment sample and a potentially usable effluent, which can be analyzed for dissolved trace elements. The continuous-flow centrifuges can process whole water at an influent feed rate of 41 per minute; however, when suspended sediment concentrations are low (< 30 mg/L), when small volumes of whole water are to be processed (30 to 40L), or when suspended sediment mean grain size is very fine (< 10 microns), influent feed rates of 21 per minute may be more efficient. Tangential-flow filtration can be used to process samples at the rate of 11 per minute. (Author's abstract)
W89-11287

EXTRACTION AND ISOLATION OF TRIAZINE HERBICIDES FROM WATER AND VEGETABLES BY A DOUBLE TRAP TANDEM SYSTEM.
Universita degli Studi 'La Sapienza', Rome (Italy). Dipt. di Chemica.
For primary bibliographic entry see Field 5A.
W89-11300

QUANTITATION OF INTERFERENCES UNDER EQUILIBRIUM CONDITIONS WITH APPLICATION TO FREE CHLORINE ANALYSIS IN THE PRESENCE OF ORGANIC CHLORAMINES.
North Carolina Univ., Chapel Hill. School of Public Health.
J. N. Jensen, and J. D. Johnson.
Analytical Chemistry ANCHEM, Vol. 61, No. 9, p 991-994, May 1, 1989. 2 fig, 4 tab, 19 ref. EPRI Grant no. RP2300-7.

Descriptors: *Water analysis, *Water treatment, *Chlorination, *Chlorine, *Chloramines, Chemical analysis, Natural waters, Equilibrium.

The measurement of free chlorine in chlorinated natural waters is subject to interference by organic chloramines. Quantitation of this interference is problematic, since organic chloramines can hydrolyze to free chlorine. This work describes a general model for the simultaneous determination of degrees of interference and analyte-interferent equilibrium constants, with application to the organic chloramine-free chlorine system is described. Amperometric membrane electrode responses ranged from 1 (N-chlorocyanurate) to 52 (N-chloro-5,5-dimethylhydantoin) times the true equilibrium of the concentration of HOCl. The model allowed for the evaluation of the hydrolysis constants of N-chlorosuccinimide (pK = 6.46), N-chlorocyanurate (pK = 4.80), and N-chloro-5,5-dimethyldantion (pK = 8.24). Interference is also significant with these chloramines. Although response factors for these chloramines relative to HOCl are small, the electrode responses are 1 to 52 times the true HOCl concentrations. Since organic chloramines are generally poor disinfectants, the electrode response is not a good measure of disinfection ability in these model systems. The model has also been used to compare analytical methods for the measurement of free chlorine in the presence of interfering organic chloramines. (Author's abstract)
W89-11301

UPTAKE OF NUCLEIC ACID PRECURSORS BY AQUATIC MICROBIAL COMMUNITIES AND PURE CULTURES OF BACTERIA AND ALGAE.
Max-Planck-Inst. fuer Limnologie zu Ploen (Germany, F.R.). Abt. Mikrobenoekologie.

For primary bibliographic entry see Field 2H.
W89-11310

MONITORING OF ACIDIFICATION BY THE USE OF AQUATIC ORGANISMS.
Bergen Univ. (Norway). Zoological Museum.
G. G. Raddum, A. Fjellheim, and T. Hesthagen.
Internationale Vereinigung fur Theoretische und Angewandte Limnologie, Verhandlungen IVTLAP, Vol. 23, No. 4, p 2291-2297, December 1988. 3 fig, 1 tab, 15 ref.

Descriptors: *Acid rain effects, *Acidification, *Norway, *Lakes, *Acidic water, *Monitoring, *Aquatic animals, *Model studies, *Tolerance, Watersheds, Seasonal variation, Snowmelt.

From 1981 to 1986, fish and invertebrates have been monitored in connection with acidification problems in western Norway. Based on tolerance limits of acid sensitive invertebrates, a model has been used to give measurable values of the degree of acidification in a watershed. Since 1982, a decline of acid deposition has been observed in western Norway. The effect of the decline in acidity on the aquatic community has varied depending on the degree of damage obtained during earlier acidification of the area. Results from two watersheds, not completely destroyed, are presented. The drop in acidification number in spring 1984 in Nausta is suggested to be due to poor water quality during snow melt. However, this was not strong enough to damage fish recruitment which increased both in 1984 and 1985. The improvements in recent years are correlated with reduced intensity of acidic episodes in the watershed. However, Nausta River is still sensitive, as shown by the spring and fall differences, and could easily be brought back to a situation similar to the late 1970's if increased acid deposition occurs again. In Vikedal River, reduction in acid deposition and improvement of water quality have been somewhat different than in Nausta. The high deposition in 1982 resulted in damage to the stream ecosystem in spring 1983. The lowest acidification value ever measured was in the fall of the same year. In both watersheds, a recovery process has been observed. The most rapid colonization occurs among sensitive invertebrates, followed by increasing densities of young Atlantic salmon. Based on invertebrate surveys, a map of western Norway showing different levels of acidification in different areas has been constructed. (Miller-PTT)
W89-11346

ANALYTICAL METHOD FOR BUTYLTIN SPECIES IN SHELLFISH,
Bowdoin Coll., Brunswick, ME. Hydrocarbon Research Center.
For primary bibliographic entry see Field 5A.
W89-11386

BIOLOGICAL ASSESSMENT OF THE WATER QUALITY IN SOUTH-HOLLAND (THE NETHERLANDS).
Hoogheemraadschap van Rijnland, Leiden (Netherlands).
S. P. Klapwijk.
Internationale Revue der Gesamten Hydrobiologie IGHYAZ, Vol. 73, No. 4, p 481-509, 1988. 5 fig, 9 tab, 75 ref.

Descriptors: *Data acquisition, *Lentic environment, *Water quality, *The Netherlands, Physical properties, Chemical properties, Cyanophyta, Microcystis, Species composition, Monitoring, Phytoplankton, Water quality standards, Chlorophyta, Diatoms.

Caspers and Karbe concluded that water quality can be assessed in three independent ways, according to the: (1) bioactivity (production/respiration), (2) oxygen regime, or (3) structure (biomass, diversity, saprobity) of the communities in the water. An elaboration of this framework for the larger stagnant waters in the province of South Holland was carried out using the phytoplankton composition and its relation with the physical and chemical water characteristics. The plankton in the South-Holland waters can be generally characterized as a green algae and diatom community. In some lakes, the plankton community is dominated by a permanent bloom of filamentous blue-greens or a periodic bloom of Microcystis aeruginosa. Morphological and hydrological watertypes, (canals, lakes, peat lakes, deep sand pits, deep pools) are reflected in the species composition, which is also determined further by the degree of pollution and eutrophication. By changing the saprobic valences of the dominant bluegreen algae from oligo/beta-mesosaprobity to alpha-meso/polysaprobity, a rather good correlation was achieved between most of the selected parameters. Only number of individual algae per ml and Margalef's index showed a rather large variation in the different classes of the scheme and could therefore be used for water quality assessment. A new scheme with measurable water quality criteria was proposed based on the framework of Caspers and Karbe's scheme. From this, a proposal is developed to quantify the water quality classes in Caspers and Karbe's scheme on parameters measuring the bioactivity, oxygen regime and phytoplankton community structure. The scheme is now incorporated in the practical water quality assessment in North-Holland and South-Holland for both routine monitoring and special water quality studies. (Miller-PTT)
W89-11390

MULTIELEMENT PRECONCENTRATRION OF TRACE METALS FROM NATURAL WATERS BY SOLVENT EXTRACTION WITH AN ALKYLATED OXINE DERIVATIVE.
McMaster Univ., Hamilton (Ontario). Dept. of Chemistry.
For primary bibliographic entry see Field 5A.
W89-11394

DEUTERIUM IN THE DEAD SEA: REMEASUREMENT AND IMPLICATIONS FOR THE ISOTOPIC ACTIVITY CORRECTION IN BRINES.
Weizmann Inst. of Science, Rehovoth (Israel). Dept. of Isotope Research.
J. Horita, and J. R. Gat.
Geochimica et Cosmochimica Acta GCACAK, Vol. 53, No. 1, p 131-133, January 1989. 2 fig, 1 tab, 13 ref.

Descriptors: *Brines, *Deuterium, *Isotope studies, *Dead Sea, *Oxygen, Salinity, Saline water, Pollutant identification.

Remeasurement of delta-deuterium in Dead Sea waters collected by the Weizmann Institute Dead Sea expedition from 1977-1982, using improved analytical techniques for handling concentrated brines, removed most of the scatter in previous data and showed close parallelism in the enrichment of both oxygen(18) and deuterium as a function of salinity. The new procedure for the isotopic analysis of water in concentrated brines first removes the offending alkaline-earth cation as insoluble carbonates, prior to the distillation of the water by azeotropic distillation with the aid of petroleum ether, using the method developed by Allison and Hughes (1983). The deuterium analysis on this distilled water then measures the true concentration value in the brine to + or - 1.5o/oo. The delta-deuterium values for a brine whose salinity is sigma(25)=232o/oo is close to +9o/oo relative to SMOW. It was further established that the concentration to activity correction (for deuterium) for the above mentioned Dead Sea brine was 17.8o/oo. (Geiger-PTT)
W89-11407

CHARACTERIZATION OF ORTHOPHOSPHATE RELEASE FROM DISSOLVED ORGANIC PHOSPHORUS BY GEL FILTRATION AND SEVERAL HYDROLYTIC ENZYMES.
Hokkaido Research Inst. for Environmental Pollution, Sapporo (Japan). Div. of Water Environment.
S. Hino.
Hydrobiologia HYDRB8, Vol. 174, No. 1, p 49-55, 2 fig, 2 tab, 21 ref.

Descriptors: *Water analysis, *Water chemistry, *Cycling nutrients, *Orthophosphates, *Phosphates, *Filtration, *Dissolved solids, Molecular weight, Phosphorus, Separation techniques, Hydrolysis.

The molecular weight distribution of dissolved organic phosphorus (DOP) and the possible mechanisms of orthophosphate (Pi) release were examined by gel filtration and incubation with some hydrolytic enzymes. Sixty five percent of the DOP appeared to have apparent molecular weights between 300 to 10,000 daltons. Less than 10% of the DOP estimated higher molecules greater than 10,000 daltons. Alkaline phosphatase released Pi more easily from low molecular weight (<1,500 daltons) DOP than from high molecular weight fractions. Addition of nucleases or phosphodiesterase alone did not appear to release Pi from high molecular weight DOP compounds. Pi release from those DOP compounds increased markedly (more than 30%) when alkaline phosphatase was incubated with nucleases or phosphodiesterase. However, 60% of DOP did not release Pi when alkaline phosphatase was incubated with either enzymes. (Author's abstract)
W89-11413

COMMUNITY PARAMETERS AND MULTIVARIATE ANALYSIS AS A MEANS OF ASSESSING THE EFFECTS OF TANNERY EFFLUENTS ON MACROBENTHOS.
National Centre for Marine Research, Athens (Greece).
For primary bibliographic entry see Field 5C.
W89-11419

CLONED RAINBOW TROUT LIVER P(1)450 COMPLEMENTARY DNA AS A POTENTIAL ENVIRONMENTAL MONITOR.
Medical Coll. of Wisconsin, Inc., Milwaukee. Dept. of Pharmacology and Toxicology.
For primary bibliographic entry see Field 5A.
W89-11431

ZOOPLANKTON BIOINDICATION SYSTEM FOR THE MATSALU BAY: A PROBABILISTIC APPROACH,
K. Remm.
Eesti NSV Teaduste Akadeemia Toimetised. Bioloogia ETATAW, Vol. 38, No. 1, p 61-71, 1989. 3 fig, 16 ref.

Descriptors: *Bays, *Water quality, *Bioindicators, *Chlorophyll a, *Zooplankton, *Probability distribution, Matsalu Bay, Distribution patterns, Prediction.

A bioindication technique is presented that includes the use of fiducial data and excludes the data where an environmental factor is limiting the indicator character, using data from Matsalu Bay. The relationships between the object character (chlorophyll a concentration in water) and the indicator characters (zooplankton parameters) were calculated as joint distributions of relative probability. A smoothing method was used, and the fiducial probabilities and relative probabilities of indicator characters were multiplied. The results were presented as the expected probability distribution of chlorophyll a values. The middle point of the most probable chlorophyll a interval was used as a point estimation for the chlorophyll a prediction. The correlation coefficient between the measured and predicted chlorophyll a values was 0.809 ($P>0.999$). Judging by the data obtained the suggested bioindication technique is effective only from the end of May to the end of September. In spite of the complexity of the ecosystem studied, that only four environmental factor besides chlorophyll a were used, and of a shortage of data, the values predicted on the basis of zooplankton were satisfactory. Bioindication is applicable for the estimation of certain single characteristics of the water environment such as pH, concentration of oxygen, chlorophyll, biogens, or any other substances in water. (Author's abstract)
W89-11461

DETERMINATION OF METHYL YELLOW, SUDAN I AND SUDAN II IN WATER BY HIGH

PERFORMANCE LIQUID CHROMATOGRAPHY.
Fukuoka Environmental Research Center (Japan).
For primary bibliographic entry see Field 5A.
W89-11469

SOLUTIONS TO PROBLEMS IN ENUMERATING SEDIMENT BACTERIA BY DIRECT COUNTS.
McGill Univ., Montreal (Quebec). Dept. of Biology.
For primary bibliographic entry see Field 5A.
W89-11509

EVALUATION OF THE METABOLISM OF SESTONIC AND EPILITHIC COMMUNITIES IN RUNNING WATERS USING AN IMPROVED CHAMBER TECHNIQUE.
Waterloo Univ. (Ontario). Dept. of Biology.
For primary bibliographic entry see Field 2H.
W89-11547

ESTIMATION OF UNSATURATED HYDRAULIC CONDUCTIVITY FROM FIELD SORPTIVITY MEASUREMENTS.
Commonwealth Scientific and Industrial Research Organization, Canberra (Australia). Div. of Environmental Mechanics.
For primary bibliographic entry see Field 2G.
W89-11570

EFFECT OF ACCESS HOLE PROPERTIES ON SOIL WATER CONTENT DETERMINATION BY NEUTRON THERMALIZATION.
North Carolina State Univ., Raleigh. Dept. of Soil Science.
A. Amoozegar, K. C. Martin, and M. T. Hoover.
Soil Science Society of America Journal SSSJD4, Vol. 53, No. 2, p 330-335, March/April 1989. 3 fig, 5 tab, 20 ref.

Descriptors: *Measuring instruments, *Neutron thermalization, *Sealants, *Neutron moisture meters, *Soil moisture meters, *Soil water, Soil engineering, Slurries, Field tests, On-site tests, Calibrations, Soil types, Kaolinite.

Installation of snugly fitted neutron access tubes in uniformly sized holes is difficult to achieve in many soils. This is especially true for areas not readily accessible by heavy machinery. The effect of access hole diameter and a kaolinite soil slurry placed around loosely fitted access tubes on soil water content determination by neutron thermalization was evaluated. Uniformly sized 5.1 (control hole), 7.6, and 9.1-cm diam. holes, and a nonuniformly sized 5.5 to 6.7-cm diam. hole were constructed at the vertices by five 80 by 80 cm. sq. plots on a Cecil soil (clayey, kaolinitic, thermic Typic Hapludult) within a small pasture. An additional uniformly sized 5.1-cm diam. hole was constructed 80 cm from the control hole at each plot. A 2-in Al irrigation pipe was used as access tubing. The access tubes were fitted tightly in the 5.1-cm holes and were placed at the center of the larger holes. A kaolinite-soil slurry was placed around the access tubes in the nonuniformly sized holes. Count ratios obtained at various depths in each hole type were linearly regressed against the count ratios for the corresponding control hole at each plot. While there was a statistically significant one to one relationship between the count ratios in the control and 5.1-cm holes, the coefficient of determination was only 0.69. The coefficients for the relationship between the count ratios for the control hole and the other three hole size treatments were between 0.61 and 0.72, and the regression coefficients decreased with increasing access hole diameter. The calibration curve coefficients of determination for the 5.1, 7.6, 9.1-cm holes and the slurry backfilled holes were 0.71, 0.62, 0.76, and 0.61, respectively. The slope of the calibration curves generally increased with increasing hole size, indicating some loss of sensitivity with the larger holes. (Author's abstract)
W89-11571

LARGE-SCALE PRECIPITATION AND OUTGOING LONGWAVE RADIATION FROM INSAT-1B DURING THE 1986 SOUTHWEST MONSOON SEASON.
National Environmental Satellite, Data, and Information Service, Washington, DC. Climate Analysis Center.
For primary bibliographic entry see Field 2B.
W89-11582

NATURAL ANALOGUES.
Disposal Safety, Inc., Washington, DC.
For primary bibliographic entry see Field 5E.
W89-11592

EXPERT SYSTEM FOR CALIBRATING SWMM.
Purdue Univ., Lafayette, IN. School of Civil Engineering.
For primary bibliographic entry see Field 2E.
W89-11597

COMPARISON OF AN INDEX FUNCTION AND A VECTORIAL APPROACH METHOD FOR RANKING WASTE DISPOSAL SITES.
National Water Research Inst., Burlington (Ontario). Lakes Research Branch.
For primary bibliographic entry see Field 5E.
W89-11623

SUCCESSFUL PRESERVATION OF DAPHNIA FOR CHEMICAL AND PHYSICAL ANALYSIS.
Minnesota Univ., Minneapolis. Limnological Research Center.
For primary bibliographic entry see Field 5A.
W89-11657

COMPARISON OF THREE TECHNIQUES FOR ADMINISTERING RADIOLABELED SUBSTRATES TO SEDIMENTS FOR TROPHIC STUDIES: INCORPORATION BY MICROBES.
Florida State Univ., Tallahassee. Dept. of Oceanography.
F. C. Dobbs, J. B. Guckert, and K. R. Carman.
Microbial Ecology MCBEBU, Vol. 17, No. 3, p 237-250, 1989. 5 fig, 5 tab, 36 ref.

Descriptors: *Isotope studies, *Limnology, *Tracers, *Radioactivity techniques, *Marine sediments, *Aquatic productivity, *Substrates, *Microorganisms, *Radioactive tracers, Injection, Isotopic tracers, Metabolism, Absorption, Lipids, Comparison studies, Interstitial water, Slurries.

Three principal methods have been used to administer substrates to sediments: injection, porewater replacement, and slurry. How each of these techniques affects incorporation of radiolabels into macromolecules of marine sedimentary microbes was assessed. Eighty-five cores of intertidal sand were collected in randomized-block, factorial design. One set of cores received 14C-bicarbonate/3H-thymidine and was incubated in the light; another set received 14C-acetate/3H-thymidine and was incubated in the dark. Following a 5-h incubation, sediments were analyzed for incorportaion of radiolabel into lipid fractions (neutral, glyco, and polar) and DNA. The three methods of isotope administration were also applied to cores subsequently analyzed for polar lipid phosphates and phospholipid fatty-acid (PLFA) profiles. In general, incorporation was greatest when injections were made, consistent with the prediction that incorporation would decrease as specific activity of the radiolabeled substrate was diminished by dilution. The ratio of 14C from acetate incorporated into polar and glycolipid fractions indicated that a significant disturbance accompanied the porewater and slurry techniques. Substantial amounts of 3H were recovered in the neutral-lipid fraction, indicating that thymidine was catabolized by sedimentary microbes and tritiated products were incorporated by eukaryotes. There were no significant differences in PLFA profiles or estimates of microbial biomass among methods or controls. Incorporation of 3H into DNA was similar with all combinations of methods and radiocarbon substrates. 14C was extensively incorporated into DNA, indicating that photoautotrophs and heterotrophs utilized radiocarbon from bicarbonate and acetate, respectively, for de novo synthesis of DNA. Injection is suggested as the method of choice, as it presents more flexibility in its application than porewater replacement and disturbs the consortia of gradients in sediments to a significantly lesser degree than porewater replacement and slurry. (Author's abstract)
W89-11664

UNBIASED PLOTTING POSITION FORMULA FOR THE GENERAL EXTREME VALUE DISTRIBUTION,
McGill Univ., Montreal (Quebec). Dept. of Civil Engineering.
For primary bibliographic entry see Field 7C.
W89-11676

EVALUATION OF ELECTROMAGNETIC TOMOGRAPHY TO MAP IN SITU WATER IN HEATED WELDED TUFF.
Lawrence Livermore National Lab., CA.
For primary bibliographic entry see Field 7C.
W89-11752

TRITIUM AS AN INDICATOR OF RECHARGE AND DISPERSION IN A GROUNDWATER SYSTEM IN CENTRAL ONTARIO.
Waterloo Univ. (Ontario). Inst. for Ground Water Research.
For primary bibliographic entry see Field 5F.
W89-11753

METHODS FOR DETERMINING TRANSVERSE DISPERSION COEFFICIENTS OF POROUS MEDIA IN LABORATORY COLUMN EXPERIMENTS.
Connecticut Univ., Storrs. Dept. of Geology and Geophysics.
For primary bibliographic entry see Field 2F.
W89-11766

DROUGHT INDICATED IN CARBON-13/CARBON-12 RATIOS OF SOUTHWESTERN TREE RINGS.
Wisconsin Univ.-Parkside, Kenosha. Dept. of Geology.
S. W. Leavitt, and A. Long.
Water Resources Bulletin WARBAQ, Vol. 25, No. 2, p 341-347, April 1989. 3 fig, 4 tab, 18 ref. Oak Ridge/Martin Marietta Subcontract 19X-22290C.

Descriptors: *Climatology, *Paleoclimatology, *Isotope studies, *Dendrochronology, *Stomatal transpiration, *Carbon, *Trees, *Drought, Water shortage, Stomata.

Stomatal closure during periods of moisture deficiency should theoretically lead to elevated C13/C12 ratios as reduction of available CO2 leads to diminished photosynthetic discrimination against C13 in favor of C12. Stable carbon isotope ratio chronologies developed from 5-yr tree ring groups at 17 sites in six southwestern states were tested for a drought relationship by first fitting a spline curve to each chronology to remove the long-term trend and calculating indices as the ratio of actual to spline curve value. The time series of 'Del Indices' so developed are significantly correlated with 5-yr mean Palmer Hydrological Drought Indices (PHDI) (post-1930 period) and reconstructed July Palmer Drought Severity Indices from respective areas. Overall, in the period since 1790, the driest pentads were 1900-04 and 1960-64, whereas the wettest were 1980-84 and 1915-19. Maps of drought represented for two pentads seem to be reasonable representations, although spatial correlations of Del Indices with PHDI were generally not significant. These Del Index drought reconstructions may provide a useful measure of past physiological response to drought (stomatal closure), although the present cost of analysis would prevent this from being a routine method. (Author's abstract)
W89-11796

REAL-TIME QUALITY CONTROL OF STREAMFLOW DATA--A SIMULATION STUDY.
Iowa Inst. of Hydraulic Research, Iowa City.
W. F. Krajewski, and K. L. Krajewski.
Water Resources Bulletin WARBAQ, Vol. 25, No. 2, p. 391-399, April 1989. 9 fig, 1 tab, 16 ref.

Descriptors: *Data quality control, *Quality control, *Data collections, *Data acquisition, *Statistical analysis, *Streamflow data, Monte Carlo method, Bird Creek, Oklahoma, Statistical studies, Flow velocity, Statistical analysis, Data interpretation.

The problem of real-time quality control of streamflow data is addressed. Five methods were investigated via a Monte Carlo simulation experiment based on streamflow data from Bird Creek basin in Oklahoma. The five methods include three deterministic approaches and two statistical problems. The relative performance of the investigated methods was evaluated under hypothesized random mechanism generating isolated outliers. The deterministic method based on streamflow gradient analysis and the statistical method based on forecast residual analysis perform best in detecting such outliers. (Author's abstract)
W89-11802

INFLUENCE OF DISSOLVED ORGANIC CARBON ON PH MEASUREMENTS OF LOW SOLUTE CONTENT WATERS,
Lockheed Engineering and Sciences Co., Inc., Las Vegas, NV. Environmental Programs Office.
For primary bibliographic entry see Field 5A.
W89-11822

ELECTROMAGNETIC DATA INTERPRETATION USING MULTIVARIATE LEAST-SQUARES REGRESSION.
Soil Testing Engineers, Inc., Baton Rouge, LA.
For primary bibliographic entry see Field 7C.
W89-11917

APPLICATION OF CROSS-WELL VOLTAGE MEASUREMENTS FOR ASSESSING FRACTURE FLOW HYDROLOGY.
Connecticut Univ., Storrs. Dept. of Geology and Geophysics.
G. A. Robbins, and J. M. Hayden.
IN: Proceedings of the FOCUS Conference on Eastern Regional Ground Water Issues, September 27-29, 1988, Stamford, Connecticut. National Water Well Association, Dublin, Ohio, 1988. p 21-38, 5 fig, 3 tab, 10 ref.

Descriptors: *Data acquisition, *Borehole geophysics, *Fracture permeability, *Geohydrology, *Groundwater movement, *Electrical properties, Observation wells, Groundwater budget, Model studies, Hydraulic conductivity, Well yield, Model studies, Field tests, Path of pollutants.

Understanding fracture hydrology is important for evaluating domestic water supply and assessing contaminant transport in the New England area. Modelling, laboratory and field studies are being conducted to evaluate the usefulness of a cross-well potential measurement technique for assessing fracture hydrology. The technique entails introduction of low frequency alternating electrical current into the fracture system from two wells and the measurement of voltage between current wells and observation wells. Through permutation of current and voltage wells, spatial variation in fracture properties can be identified. Modelling of voltage and current data provides information on fracture characteristics. Aperture widths calculated based on flow and electrical tests for a physical fracture model showed close agreement. Therefore, the technique potentially provides means of determining the hydraulic conductivity of fractures and estimates of well yields. Field tests have been conducted in the Bigelow Brook Formation in northeastern Connecticut which is characterized by schist interlayered with gneiss, with fractures parallel to folitation. Results of modelling are being assessed in consideration of outcrop, core, hydrologic, water quality, and laboratory and surface resistivity data. Analyses of the electrical test data suggest reasonable correspondence between calculated fracture and rock properties and those determined through independent observations, measurements and tests. (See also W89-11916) (Author's abstract)
W89-11918

APPLYING SEISMIC REFLECTION TECHNIQUES TO HYDROGEOLOGICAL INVESTIGATIONS.
Gartner Lee, Inc., Niagara Falls, NY.
D. Slaine.
IN: Proceedings of the FOCUS Conference on Eastern Regional Ground Water Issues, September 27-29, 1988, Stamford, Connecticut. National Water Well Association, Dublin, Ohio, 1988. p 39-52, 4 fig, 9 ref.

Descriptors: *Data acquisition, *Geophysics, *Seismic properties, *Geohydrology, *Seismic waves, Silt, Clays, Hydraulic conductivity, Permeability, Sand, Stratigraphy, Aquifers, Well yield, Aquifer characteristics.

Shallow seismic reflection surveys were performed at two sites as reconnaissance studies in major geohydrological investigations. The purpose of the seismic survey at the first site was to determine the continuity of subsurface overburden conditions between borehole locations at a proposed hazardous waste treatment facility. Variations in overburden stratigraphy identified by the seismic survey were selected for subsequent drilling investigations. The purpose of the seismic survey at the second site was to map overburden stratigraphy and bedrock topography in order to select drilling locations in a groundwater supply investigation. Excellent seismic results were obtained for both sites. The 'optimum offset' shallow seismic reflection technique with a geophone spacing of 5 m was used at both sites. The data were recorded on a 12-channel engineering seismograph, using a single 100 Hz geophone per channel, and a 12 gauge in-hole shotgun source. Processing and data analysis were performed on a microcomputer. The seismic and geologic information gathered at the first site showed continuous deposits of silt clay sequences overlying a sandy till which veneered the dolostone bedrock. The low permeability silt clay sequences were found at depths of about 30 m beneath the proposed facility. Continuous reflectors were mapped between two of the silt clay units, the contact of the lower silt clay unit and the sandy till, and at the contact of the till and bedrock. At the second site, glacial moraine deposits of sands and tills were mapped to depths of about 140 m. Zones with complex overburden stratigraphy indicative of rapid depositional environments of coarse grained sediments were prioritized for drilling. An aquifer with a well yield of 45 L/s (700 gallons per minute) was successfully mapped. The seismic sections also delineated a buried bedrock valley that cut 100 m into the bedrock and had an overall depth of 244 m. Drilling and subsequent test pumping of sand deposits within the buried valley showed poor aquifer material. (See also W89-11916) (Author's abstract)
W89-11919

USE OF GROUND-PENETRATING RADAR IN DEFINING GLACIAL OUTWASH AQUIFERS.
BCI Geonetics, Inc., Laconia, NH.
K. R. Taylor, and M. E. Baker.
IN: Proceedings of the FOCUS Conference on Eastern Regional Ground Water Issues, September 27-29, 1988, Stamford, Connecticut. National Water Well Association, Dublin, Ohio, 1988. p 77-98, 12 fig, 7 ref.

Descriptors: *Aquifer characteristics, *Geophysics, *Glacial aquifers, *Ground penetrating radar, *Data acquisition, *Remote sensing, Radar, Geohydrology, Glaciohydrology, Permeability, Soil water, Stratigraphy, Groundwater movement, Groundwater recharge, Clays, Soil properties, Outwash.

Ground penetrating radar (GPR) has been applied in the analysis of a glacial outwash aquifers in Gray, Maine. This work comprised a step in the development of a conceptual geohydrologic model for groundwater exploration and protection studies. The radar data significantly aided in determining the areal and vertical distribution of both outwash materials and low permeability clay-rich sediments. Water table depths were also clearly identified in most cases. GPR was found to be especially useful in identifying geologic contacts between high permeability outwash sediments and low permeability clays. Stratigraphic variations in glacial sediments identified with GPR allowed estimates of saturated sand and gravel thicknesses. The accuracy of these interpretations was checked by well logs and water table measurements. GPR data lead to the following conclusions regarding the geohydrology of the area: (1) marine clay and a suspected confined aquifer do not exist beneath the outwash delta; (2) buried moraines that could affect groundwater flow at depth are present beneath the delta; (3) whereas the distal part of the delta consists of uniform sand and minor gravel, the proximal part is composed of more disturbed and coarser-grained sediments; and (4) contacts between the clay and sand mapped from soils and topography are probably accurate. All of these conclusions allowed a more accurate determination of the recharge areas, a better understanding of the local groundwater flow dynamics, and finally the development of a geohydrologic model supported by hard data. In summary, GPR is a rapid, cost-effective method of investigation for the analysis of glacial outwash aquifers, whether in determining recharge areas for aquifer protection studies or in the exploration for new groundwater supplies. (See also W89-11916) (Lantz-PTT)
W89-11921

RAPID RISE OF SHALLOW GROUNDWATER TABLES ON INFILTRATION-PRELIMINARY RESULTS AND IMPLICATIONS ON AQUIFER CONTAMINATION.
Rutgers - The State Univ., New Brunswick, NJ.
For primary bibliographic entry see Field 2F.
W89-11935

IMPROVED FIELD TECHNIQUES FOR HYDRAULIC PROPERTIES OF SOILS.
Wisconsin Univ., Madison. Dept. of Soil Science.
J. Bouma.
IN: Water Pollution Control in Low Density Areas: Proceedings of a Rural Environmental Engineering Conference, September 26-28, 1973, Warren, Vermont. University Press of New England, Hanover, New Hampshire, 1975. p 181-189, 3 fig, 9 ref.

Descriptors: *Data acquisition, *Septic tanks, *Soil disposal fields, *Soil water, *Hydraulic conductivity, *Field tests, Infiltration, Soil saturation, Soil properties.

Soil suitability for the disposal of septic tank effluent is determined on the basis of several criteria, one of which is the percolation rate of the soil. The percolation test is useful to rank the relative capacity of different soils to accept water when applied 6 inches high in a 6-in. diameter hole. But the test does not yield a representative rate of the movement of waste liquid into soil surrounding a seepage bed or trench. Real flow conditions around operating seepage beds in the field are often governed by processes of unsaturated flow because of crusting or clogging of infiltrative surfaces and associated ponding of effluent in seepage beds. Prediction of flow conditions in the soil requires, therefore, knowledge of the hydraulic conductivity (K) of the soil under both saturated and unsaturated conditions. K-data is physically well defined in that any K value represents the real flow in a one-dimensional system at a hydraulic gradient of 1 cm/cm. Several in situ field tests have been developed in recent years which are preferable to laboratory methods where disturbed samples may perhaps be tested. The double-tube method can be applied to measure K of saturated soil. The crust test was developed in Wisconsin to measure unsaturated K-values. K-values were determined from infiltration rates at unit hydraulic gradient into crust-capped soil columns 30 cm high carved out in situ. Matric suctions were measured with

tensionmeters. A crust on top of an infiltrating profile causes a potential head loss at that point. Thus, if the water head over the crust is kept small, it is possible to maintain infiltration into an unsaturated column yet retain the experimental advantages of an easily measured inflow rate afforded by a flood infiltrometer. Only one other field test for measurement of K-unsat, the instantaneous profile method, is available and is currently part of the field testing program in Wisconsin. In this method, the complete soil profile is initially saturated. The decrease of the moisture content in the different horizons due to drainage is monitored as a function of time with tensiometry and the neutron probe. Evapotranspiration is avoided by covering the soil. K-curves of the different horizons can be calculated with the drainage data. The instantaneous profile method is not very suitable to obtain K-values close to saturation. (See also W89-11953) (Lantz-PTT)
W89-11968

USE OF AN INSTRUMENTED CONE PENETROMETER IN MONITORING LAND DISPOSAL SITES.
Army Engineer Waterways Experiment Station, Vicksburg, MS.
For primary bibliographic entry see Field 5B.
W89-12060

APPLICATIONS OF FIELD HEADSPACE ANALYSIS AND SOIL GAS ANALYSIS USING AN ORGANIC VAPOR METER TO ASSIST IN IDENTIFYING LABORATORY SAMPLE LOCATIONS.
Storch Engineers, Florham Park, NJ.
For primary bibliographic entry see Field 5B.
W89-12061

OBJECTIVES ASSESSMENT OF 1984-85 VAS PRODUCTS AS INDICES OF THUNDERSTORM AND SEVERE LOCAL STORM POTENTIAL.
National Weather Service, Silver Spring, MD. Techniques Development Lab.
For primary bibliographic entry see Field 2B.
W89-12078

TECHNOLOGY ASSESSMENT OF FIELD PORTABLE INSTRUMENTATION FOR USE AT ROCKY MOUNTAIN ARSENAL.
Oak Ridge National Lab., TN. Analytical Chemistry Div.
For primary bibliographic entry see Field 5A.
W89-12079

DIRECT DETERMINATION OF PART-PER-BILLION LEVELS OF VOLATILE ORGANICS IN WATER AND SOIL SAMPLES USING GLOW DISCHARGE MASS SPECTROMETRY.
Oak Ridge National Lab., TN. Analytical Chemistry Div.
For primary bibliographic entry see Field 5A.
W89-12080

MICROCHEMICAL ANALYSIS OF FISH HARD PARTS FOR RECONSTRUCTING HABITAT USE: PRACTICE AND PROMISE.
Oak Ridge National Lab., TN. Environmental Sciences Div.
For primary bibliographic entry see Field 2H.
W89-12100

OIL POLLUTION SAMPLING, DETECTION, AND ANALYSIS, JANUARY 1976-JANUARY 1988: CITATIONS FROM THE NTIS BIBLIOGRAPHIC DATABASE.
National Technical Information Service, Springfield, VA.
For primary bibliographic entry see Field 5A.
W89-12162

7C. Evaluation, Processing and Publication

THEORETICAL AND EXPERIMENTAL ANALYSIS OF PSEUDOMONAS AERUGINOSA BIOFILM.
Montana State Univ., Bozeman. Inst. for Biological and Chemical Process Analysis.
For primary bibliographic entry see Field 5D.
W89-11076

MODELING MICROBIAL TRANSPORT IN POROUS MEDIA.
Montana State Univ., Bozeman. Inst. for Biological and Chemical Process Analysis.
For primary bibliographic entry see Field 5B.
W89-11149

ESTIMATING THE WATER QUALITY BENEFITS FROM SOIL EROSION CONTROL.
Economic Research Service, Washington, DC. Resources and Technology Div.
For primary bibliographic entry see Field 5G.
W89-11162

VERIFIABLE EVAPORATION MODELING ON THE LAURENTIAN GREAT LAKES.
National Oceanic and Atmospheric Administration, Ann Arbor, MI. Great Lakes Environmental Research Lab.
For primary bibliographic entry see Field 2D.
W89-11249

PROBABILISTIC STORM TRANSPOSITION APPROACH FOR ESTIMATING EXCEEDANCE PROBABALITIES OF EXTREME PRECIPITATION DEPTHS,
Iowa State Univ., Ames. Dept. of Civil Engineering.
For primary bibliographic entry see Field 2B.
W89-11251

ASSESSING THE VALIDITY OF THE CHANNEL MODEL OF FRACTURE APERTURE UNDER FIELD CONDITIONS.
Geological Survey, Reston, VA.
For primary bibliographic entry see Field 2F.
W89-11252

BOUNDARY CONDITIONS AND POINT SOURCES IN THE FINITE ELEMENT INTEGRATION OF THE TRANSPORT EQUATION,
Centro di Ricerca Idraulica e Strutturale, Milan (Italy).
For primary bibliographic entry see Field 2F.
W89-11255

DISCRETE KERNEL METHOD OF CHARACTERISTICS MODEL OF SOLUTE TRANSPORT IN WATER TABLE AQUIFERS,
Colorado Univ. at Boulder. Dept. of Civil, Environmental, and Architectural Engineering.
For primary bibliographic entry see Field 5B.
W89-11256

REDOX-CONTROLLED MULTIPLE-SPECIES REACTIVE CHEMICAL TRANSPORT: 1. MODEL DEVELOPMENT.
California Univ., Berkeley. Dept. of Materials Science and Mineral Engineering.
For primary bibliographic entry see Field 2K.
W89-11257

REDOX-CONTROLLED MULTIPLE-SPECIES REACTIVE CHEMICAL TRANSPORT: 2. VERIFICATION AND APPLICATION.
California Univ., Berkeley. Dept. of Materials Science and Mineral Engineering.
For primary bibliographic entry see Field 2K.
W89-11258

FLOOD FREQUENCY ANALYSIS WITH REGIONAL AND HISTORICAL INFORMATION.
Cornell Univ., Ithaca, NY. School of Civil and Environmental Engineering.
For primary bibliographic entry see Field 2E.
W89-11260

SIMPLE ANALYTIC FUNCTIONS FOR MODELING THREE-DIMENSIONAL FLOW IN LAYERED AQUIFERS.
GeoTrans, Inc., Harvard, MA.
For primary bibliographic entry see Field 2F.
W89-11262

WATER AND SURFACE ENERGY BALANCE MODEL WITH A MULTILAYER CANOPY REPRESENTATION FOR REMOTE SENSING PURPOSES.
National Aeronautics and Space Administration, Greenbelt, MD. Hydrological Sciences Branch.
For primary bibliographic entry see Field 7B.
W89-11263

REGIONAL FLOOD QUANTILE ESTIMATION FOR A WEIBULL MODEL.
Colorado State Univ., Fort Collins. Dept. of Statistics.
For primary bibliographic entry see Field 2E.
W89-11265

EVALUATION OF A LINEAR BANK EROSION EQUATION.
Delaware Univ., Newark. Dept. of Geology.
For primary bibliographic entry see Field 2J.
W89-11267

CHANNEL LENGTH-MAGNITUDE FORMULA FOR RANDOM NETWORKS: A SOLUTION TO MOON'S CONJECTURE,
Oregon State Univ., Corvallis. Dept. of Mathematics.
For primary bibliographic entry see Field 2J.
W89-11271

ESTIMATING WATER TABLE ALTITUDES FOR REGIONAL GROUNDWATER FLOW MODELING, U.S. GULF COAST.
Texas Univ. at Austin. Dept. of Geological Sciences.
For primary bibliographic entry see Field 2F.
W89-11276

GROUNDWATER MODELING FOR SALINITY MANAGEMENT: AN AUSTRALIAN CASE STUDY.
Australian National Univ., Canberra. Centre for Resource and Environmental Studies.
For primary bibliographic entry see Field 2F.
W89-11281

USE OF THE STRUCTURAL MODEL FOR THE ASSESSMENT OF ENVIRONMENTAL IMPACT ON COASTAL FISHERIES: PRINCIPLES AND PROCEDURES,
Tokyo Univ. (Japan). Ocean Research Inst.
For primary bibliographic entry see Field 5C.
W89-11289

USE OF THE STRUCTURAL MODEL FOR THE ASSESSMENT OF ENVIRONMENTAL IMPACT ON COASTAL FISHERIES: AN APPLICATION,
Tokyo Univ. (Japan). Ocean Research Inst.
For primary bibliographic entry see Field 4C.
W89-11290

DISTRIBUTIONAL ECOLOGY OF RED-CAPPED PLOVER, CHARADRIUS RUFICAPILLUS (TEMMINCK, 1822), ON WESTERN AUSTRALIAN SALT LAKES.
Western Australia Univ., Nedlands. Dept. of Zoology.

For primary bibliographic entry see Field 2H.
W89-11295

NON-LINEAR RESPONSE OF WET DEPOSITION TO EMISSIONS REDUCTION: A MODEL STUDY.
Ontario Ministry of the Environment, Rexdale.
For primary bibliographic entry see Field 5G.
W89-11452

STATIC EQUILIBRIUM BAYS: NEW RELATIONSHIPS.
Western Australia Univ., Nedlands. Dept. of Civil Engineering.
For primary bibliographic entry see Field 2L.
W89-11470

MATHEMATICAL MODELING OF FLUVIAL SAND DELIVERY.
San Diego State Univ., CA. Dept. of Civil Engineering.
For primary bibliographic entry see Field 2J.
W89-11472

WAVE GROUPING EFFECT IN IRREGULAR WAVE AGITATION IN HARBORS.
Laval Univ., Quebec. Dept. of Civil Engineering.
For primary bibliographic entry see Field 8B.
W89-11473

APPROXIMATE WATER LEVEL CHANGES IN WELLS COMPLETED IN THE CHICOT AND EVANGELINE AQUIFERS, 1977-89 AND 1988-89, AND MEASURED COMPACTION, 1973-89, IN THE HOUSTON-GALVESTON REGION, TEXAS.
Geological Survey, Austin, TX. Water Resources Div.
D. L. Barbie, L. S. Coplin, and C. W. Bonnet.
Available from Books and Open File Report Section, USGS, Box 25425, Denver, CO 80225: paper copy $2.00, microfiche $7.00. USGS Open-File Report 89-057, 1989, 7 sheets (maps), 6 fig.

Descriptors: *Houston, *Galveston, *Water level fluctuations, *Subsidence, *Texas, *Maps, Coastal aquifers.

Measurements of water levels in 307 wells completed in the Chicot and Evangeline aquifers were used to construct maps showing approximate water level changes during 1977-89 and 1988-89. Compaction data were obtained from 12 wells equipped with compaction monitors at 11 sites during 1973-89. (USGS)
W89-11480

MAPS SHOWING ALTITUDE OF THE POTENTIOMETRIC SURFACE AND CHANGES IN WATER LEVELS IN THE SPARTA-MEMPHIS AQUIFER IN EASTERN AND SOUTHERN ARKANSAS, SPRING 1986.
Geological Survey, Little Rock, AR. Water Resources Div.
J. Edds, and D. J. Fitzpatrick.
Available from Books and Open File Report Section, USGS, Box 25425, Denver, CO 80225. USGS Water-Resources Investigations Report 88-4042, April 1989. 1 (map) sheet, 3 fig, 12 ref.

Descriptors: *Maps, *Potentiometric level, *Groundwater level, *Arkansas, *Sparta-Memphis Aquifer, Groundwater, Water level.

The Sparta-Memphis aquifer is a major source of industrial and public water supplies as well as a source of water for agricultural purposes in eastern and south-central Arkansas. The potentiometric-surface map for this aquifer, compiled from wastewater level measurements made during spring 1986, indicates a generally eastward and southward hydraulic gradient. The potentiometric surface also shows three major cones of depression resulting from groundwater withdrawals for industrial and public supplies; one centered in Columbia County, one in Union County, and one in Jefferson County. The water level change maps for the Sparta-Memphis aquifer for the period between spring 1981 and spring 1986 show large areas of both rise and decline in water levels across the study area. Largest rises occurred in parts of Jefferson, Columbia, and Phillips Counties, whereas largest declines occurred in parts of Union County. (USGS)
W89-11481

POTENTIOMETRIC SURFACE OF THE AQUIA AQUIFER IN SOUTHERN MARYLAND DURING THE FALL OF 1987.
Geological Survey, Towson, MD. Water Resources Div.
F. K. Mack, D. C. Andreasen, S. E. Curtin, and J. C. Wheeler.
Available from Books and Open File Report Section, USGS, Box 25425, Denver, CO 80225. USGS Water-Resources Investigations Report 89-4012, 1989. 1p.

Descriptors: *Maps, *Potentiometric level, *Confined aquifers, *Coastal plains, *Maryland, *Groundwater level, Wells, Maryland, Anne Arundel County, Prince Georges County, Calvert County, Charles County, St Marys County, Cone of depression, Aquia aquifer.

A map showing the potentiometric surface of the Aquia aquifer in the Paleocene Aquia Formation in southern Maryland during the fall of 1987 was prepared by using water level measurements from 80 observation wells. The potentiometric surface was above sea level near the northeastern boundary and outcrop area of the aquifer in topographically high areas of Anne Arundel and Prince Georges Counties. The potentiometric surface was below sea level in the remainder of the study area. The hydraulic gradient was generally to the southeast toward an extensive cone of depression, which is centered around well fields near Lexington Park. Much of the cone is more than 40 ft below sea level. (USGS)
W89-11485

POTENTIOMETRIC SURFACE OF THE MAGOTHY AQUIFER IN SOUTHERN MARYLAND DURING THE FALL OF 1987.
Geological Survey, Towson, MD. Water Resources Div.
F. K. Mack, D. C. Andreasen, S. E. Curtin, and J. C. Wheeler.
Available from Books and Open File Report Section, USGS, Box 25425, Denver, CO 80225. USGS Water-Resources Investigations Report 89-4013, 1987. 1p.

Descriptors: *Potentiometric level, *Maps, *Confined aquifers, *Coastal plains, *Groundwater level, Maryland, Wells, Anne Arundel County, Prince Georges County, Calvert County, Charles County, Cone of depression, Magothy Aquifer.

A map showing the potentiometric surface of the Magothy aquifer in the Cretaceous Magothy Formation in southern Maryland during the fall of 1987 was prepared by using water level measurements in 85 observation wells. The potentiometric surface was highest near the northwestern boundary and outcrop area of the aquifer in topographically high locations of Anne Arundel and Prince Georges Counties. The hydraulic gradient in the study area was generally southeastward or toward the centers of three cones of depression which have developed in response to pumping stresses. These cones formed around well fields in the Annapolis, Waldorf, and Chalk Point areas. The potentiometric surface of the Magothy aquifer was more than 40 ft below sea level in parts of the Waldorf and Chalk Point areas. (USGS)
W89-11486

ALTITUDE AND CONFIGURATION OF THE POTENTIOMETRIC SURFACE IN THE TRIASSIC SANDSTONES AND SHALES, NORTHEASTERN CHESTER COUNTY, PENNSYLVANIA, SEPTEMBER 1987 THROUGH JANUARY 1988.
Geological Survey, Malvern, PA. Water Resources Div.
L. A. Senior, and J. A. Garges.
Available from Books and Open File Report Section, USGS, Box 25425, Denver, CO 80225. USGS Water-Resources Investigations Report 89-4043, 1988. 1 map sheet.

Descriptors: *Groundwater level, *Contours, *Maps, *Chester County, *Pennsylvania, Water table, Sandstones, Shales.

The altitude of the water levels in the Triassic sandstones and shales in northeastern Chester County is shown on a map at a scale of 1:24,000. The map is based on water levels in 173 nonpumping drilled and dug wells measured in 1956 and 1965, and on the altitude of two springs that were flowing in November and December 1987. Water level altitudes are contoured at an interval of 20 ft. The surface defined by the contoured water levels may approximately represent the water table. Water table altitudes range from 379 ft to less than 80 ft above sea level. (USGS)
W89-11493

LINEAR MODEL OF EXTERNAL INTERACTIONS DURING UPTAKE OF DIFFERENT FORMS OF INORGANIC NITROGEN BY MICROALGAE.
Centre de Recherche en Ecologie Marine et Aquaculture, Nieul sur Mer (France).
For primary bibliographic entry see Field 2L.
W89-11561

SIMPLE APPROXIMATE EQUATION TO CALCULATE DIFFUSIVITIES FROM ONE-STEP OUTFLOW EXPERIMENTS.
Agricultural Coll. of Athens (Greece). Lab. of Agricultural Hydraulics.
For primary bibliographic entry see Field 2G.
W89-11572

RELATING POINT TO AREA AVERAGE RAINFALL IN SEMIARID WEST AFRICA AND THE IMPLICATIONS FOR RAINFALL ESTIMATES DERIVED FROM SATELLITE DATA.
Reading Univ. (England). Dept. of Meteorology.
For primary bibliographic entry see Field 2B.
W89-11579

STUDY ON WATER QUALITY CHARACTERISTICS AND WATER QUALITY MODEL IN SUYEONG ESTUARY.
National Fisheries Univ. of Pusan (Republic of Korea). Dept. of Environmental Science and Engineering.
For primary bibliographic entry see Field 5G.
W89-11607

ANAEROBIC DIGESTION KINETICS OF WINE-DISTILLERIES WASTEWATERS.
Cadiz Univ. (Spain). Dept. of Chemical Engineering.
For primary bibliographic entry see Field 5D.
W89-11672

UNBIASED PLOTTING POSITION FORMULA FOR THE GENERAL EXTREME VALUE DISTRIBUTION.
McGill Univ., Montreal (Quebec). Dept. of Civil Engineering.
N. In-Na, and V. Nguyen.
Journal of Hydrology JHYDA7, Vol. 106, No. 3/4, p 193-209, April 20 1989. 3 fig, 6 tab, 29 ref.

Descriptors: *Probability distribution, *Frequency analysis, *Graphical methods, *Statistical methods, Numerical analysis, Statistical analysis, Mathematical studies, Hydrology, Civil engineering.

Probability plots or plotting positions have been discussed for several decades by hydrologists and statisticians. In particular, plotting positions have been commonly used in hydrologic frequency analysis in a variety of ways e.g., to estimate the magnitude of hydrologic events and its corresponding probability of occurrence, to detect out-

liers, to fit distributions to data, and to evaluate the adequacy of the fit. Although some analytical procedures for estimating distribution parameters (such as probability weighted moments and maximum likelihood) are considered, in theory, more efficient than the graphical fitting methods, the probability plots are still widely used in engineering practice. A new unbiased plotting position formula for the General Extreme Value distribution (GEV) is introduced. The probability weighted moment (PWM) method is used to estimate the exact plotting positions. For practical application purposes, a simple formula representing a very reliable approximation to the exact plotting position is proposed. It is found that the suggested formula provides a better agreement to the exact plotting positions than several existing formulas. Further, the proposed formula is conceptually more flexible and computationally more convenient because it can take explicitly into account the skewness coefficient of the underlying distribution. It can be concluded that the plotting position formula developed in this study is the most appropriate for the GEV distribution. Finally, the development of probability papers for the GEV distribution for various skewness values is presented. Results of a numerical example have demonstrated the advantages related to the use of these special probability papers in engineering practice. (Author's abstract)
W89-11676

NEW PROCEDURE FOR GRIDDING ELEVATION AND STREAM LINE DATA WITH AUTOMATIC REMOVAL OF SPURIOUS PITS,
Commonwealth Scientific and Industrial Research Organization, Wembley (Australia). Div. of Water Resources.
M. F. Hutchinson.
Journal of Hydrology JHYDA7, Vol. 106, No. 3/4, p 211-232, April 20 1989. 11 fig, 57 ref.

Descriptors: *Topographic mapping, *Terrain analysis, *Geomorphology, Drainage, Algorithms, Statistical methods, Hydrology, Mathematical studies, Topography, Elevation.

A morphological approach to the interpolation of regular grid digital elevation models (DEMs) from surface specific elevation data points and selected stream lines is presented. The approach has given rise to a computationally efficient interpolation procedure that couples the minimization of a terrain specific roughness penalty with an automatic drainage enforcement algorithm. The drainage enforcement algorithm removes spurious sinks or pits yielding DEMs that may be used to advantage in hydrological studies. The drainage enforcement algorithm has also been found to significantly increase the accuracy of DEMs interpolated from sparse, but well-chosen, surface specific elevation data. Moreover, it facilitates the detection of errors in elevation data that would not be detected by more conventional statistical means and forms a sound physical basis for cartographic generalization. (Author's abstract)
W89-11679

STOCHASTIC CLUSTER MODEL FOR HOURLY PRECIPITATION DATA,
Oregon State Univ., Corvallis. Dept. of Agricultural Engineering.
For primary bibliographic entry see Field 2B.
W89-11680

ASSESSING THE IMPACTS OF STREAM REGULATION IN THE FLATHEAD RIVER BASIN, MONTANA, U.S.A. I. SIMULATION MODELLING OF SYSTEM WATER BALANCE.
Montana Univ., Polson. Flathead Lake Biological Station.
For primary bibliographic entry see Field 4A.
W89-11698

ABILITY OF PHABSIM TO PREDICT CHINOOK SALMON SPAWNING HABITAT.
Department of Fisheries and Oceans, Nanaimo (British Columbia). Pacific Biological Station.
For primary bibliographic entry see Field 8I.
W89-11717

ANALYSIS OF BROWN TROUT (SALMO TRUTTA FARIO L.) HABITAT: THE ROLE OF QUALITATIVE DATA FROM EXPERT ADVICE IN FORMULATING PROBABILITY-OF-USE CURVES,
Aix-Marseille-1 Univ. (France). Lab. d'Hydrobiologie.
For primary bibliographic entry see Field 2H.
W89-11719

PARAMETER ESTIMATION FOR THE GENERAL EXTREME VALUE DISTRIBUTION.
Asian Inst. of Tech., Bangkok (Thailand).
H. N. Phien, and E. T. S. Fang.
Water SA WASADV, Vol. 15, No. 2, p 57-64, April 1989. 6 tab, 24 ref.

Descriptors: *Statistical methods, *Extreme values, *Frequency distribution, *Statistics, *Flood frequency, Monte Carlo method, Maximum likelihood method, Variance, Censoring, Bias, Errors, Akaike information criterion, Mathematical models, Comparison studies, Estimating, Analysis of variance.

The magnitude of extreme events may be taken, to a reasonable approximation, as being distributed according to one of the three extreme-value distributions defined by Fisher and Tippet in 1928. These were combined by Jackson into a general (or generalized) extreme value distribution (GEV) using a transformation and reparameterization of the three-parameter Weibull distribution. In practical applications, the three parameters of the GEV must be estimated from sample data. For complete samples, Jenkinson's method of sextiles, method of probability-weighted moments (PWM), and method of maximum likelihood (ML) can be used. In the present study, and extension of the PWM was made for the case of censored samples. Monte Carlo experiments were conducted to compare the performance of the ML and PWM methods on such samples, and to investigate the effect of censoring on the estimates of the T-year flood. Type I censoring was employed because results related to Type II are readily available elsewhere and Type I censoring is commonly encountered with measurement devices. For complete samples, the PWM provided estimators that are less biased than the ML estimators. For the variances/covariances of the parameter estimators, the PWM had a comparable efficiency to the ML. However, for the extreme quantiles, the PWM estimators had much larger variances. For censored samples, the extension provided here for the PWM did not perform satisfactorily in terms of the bias and variances of the estimators. The ML, in contrast, still functioned well. It can reduce the bias and even the variances of the estimators at some censoring levels. The Akaike information criterion, used along with the ML estimators, can identify the extremal models with a high accuracy level for both complete and censored samples. (Rochester-PTT)
W89-11742

ADDITION OF A CLIMATE VARIABLE TO THE HOWE AND LINAWEAVER WESTERN SPRINKLING EQUATION.
Wilson (Lee) and Associates, Inc., Santa Fe, NM.
For primary bibliographic entry see Field 3D.
W89-11750

EVALUATION OF ELECTROMAGNETIC TOMOGRAPHY TO MAP IN SITU WATER IN HEATED WELDED TUFF.
Lawrence Livermore National Lab., CA.
W. Daily, and A. Ramirez.
Water Resources Research WRERAO, Vol. 25, No. 6, p 1083-1096, June 1989. 6 fig, 26 ref, append, 6 plates. DOE Contract W-7405-ENG-48.

Descriptors: *Tomography, *Geophysics, *Remote sensing, *Geotomography, *Nevada Test Site, *Radioactive waste disposal, *Moisture content, Performance evaluation, Rock properties, Heat sensing, Rock fractures, Tunnels, Tuff, Spatial distribution.

An experiment was conducted in the G tunnel complex at the Nevada Test Site to evaluate geotomography as a possible candidate for in situ monitoring of moisture content near a heater in densely welded tuff. Alterant tomographs of electromagnetic permittivity at 200 MHz were made of the densely welded tuff in two planes near a heater, which was used to simulate a thermal load of a nuclear waste container. When the 1-kW heater was turned on, the tomographs indicated a rapid and strong drying adjacent to the heater. Moisture loss was not symmetric about the heater but seemed to be influenced strongly by heterogeneity in the rock mass. The linear character of many tomographic features and their spatial correlation with fractures mapped in boreholes are evidence that drying was most rapid along certain fractures. When the heater was turned off, an increase in moisture content occurred around the heater and along the dry fractures. However, this process is much slower and the magnitude of the moisture increase much smaller than the changes observed during heating of the rock. The interpretation of the tomographs is preliminary until they can be processed without the restrictive assumption of straight ray paths for the signals through the highly heterogeneous rock mass. However, from these preliminary results it is concluded that geotomography can provide useful moisture content information near a heater in densely welded tuff. This conclusion is based on the fact that the experimental results and their interpretation are self-consistent and in good agreement with behavior expected of the heated rock mass. (Author's abstract)
W89-11752

SYMMETRIC-MATRIX TIME INTEGRATION SCHEME FOR THE EFFICIENT SOLUTION OF ADVECTION-DISPERSION PROBLEMS,
Karlsruhe Univ. (Germany, F.R.). Inst. fuer Hydromechanik.
For primary bibliographic entry see Field 5B.
W89-11756

NUMERICAL INVESTIGATION OF THE CONJUGATE GRADIENT METHOD AS APPLIED TO THREE-DIMENSIONAL GROUNDWATER FLOW PROBLEMS IN RANDOMLY HETEROGENEOUS POROUS MEDIA,
Illinois Univ. at Urbana-Champaign. Dept. of Civil Engineering.
P. D. Meyer, A. J. Valocchi, S. F. Ashby, and P. E. Saylor.
Water Resources Research WRERAO, Vol. 25, No. 6, p 1440-1446, June 1989. 1 fig, 4 tab, 19 ref. USGS Grant 14-08-001-G1299, U.S. DOE Grant DOE DEFG02-87ER25026, and NSF Grant DMS 8703226.

Descriptors: *Model studies, *Groundwater movement, *Porous media, *Computer programs, Data processing, Conjugate Gradient Method, Algorithms, Supercomputers, Mathematical models, Polynomials, Mathematical equations.

Field-scale modeling of three-dimensional groundwater flow in randomly heterogeneous porous media is considered. The system of linear equations resulting from the finite difference discretization of this problem easily may involve more than a million unknowns. Problems of such magnitude can be solved practically only on supercomputers and require an efficient iterative solution method that is well suited to the architecture of the particular computer being used. The preconditioned conjugate gradient method is highly efficient for this groundwater flow problem, and by using an appropriate preconditioning matrix the method can be adapted to different computers. The numerical software package CgCode enhances this adaptability. The user of CgCode must provide only subroutines for preconditioning and matrix-vector multiplication. These subroutines could be tailored to the specific problem and machine architecture. Numerical results demonstrating the efficiency of polynomial preconditioning for the conjugate gradient on both a vector machine (Cray X-MP/48) and a vector-parallel machine (Alliant FX/8) are presented. In these test problems the Turning-Bands

method was used to generate the three-dimensional ln K (hydraulic conductivity) fields. The most difficult test problem involved 980,000 unknowns and had a ln K standard deviation of 2.3. The head field solution for this problem was obtained in 59 central processing unit minutes. With correct choice of the proper iterative method and preconditioner, it is possible to solve large groundwater problems fairly cheaply. (Rochester-PTT)
W89-11783

INTERPLAY BETWEEN PARAMETER UNCERTAINTY AND MODEL AGGREGATION ERROR.
Texas Univ. at Dallas, Richardson. Graduate Program in Environmental Sciences.
For primary bibliographic entry see Field 5B.
W89-11788

OPTIMAL ESTIMATION OF CONTAMINANT TRANSPORT IN GROUND WATER.
Kansas Univ., Lawrence. Dept. of Civil Engineering.
For primary bibliographic entry see Field 5B.
W89-11790

REAL-TIME QUALITY CONTROL OF STREAMFLOW DATA--A SIMULATION STUDY.
Iowa Inst. of Hydraulic Research, Iowa City.
For primary bibliographic entry see Field 7B.
W89-11802

MERITS OF STATISTICAL CRITERIA FOR THE PERFORMANCE OF HYDROLOGICAL MODELS.
Eidgenoessisches Inst. fuer Schnee- und Lawinenforschung, Davos (Switzerland).
J. Martinec, and A. Rango.
Water Resources Bulletin WARBAQ, Vol. 25, No. 2, p 421-432, April 1989. 12 fig, 2 tab, 5 ref.

Descriptors: *Performance evaluation, *Statistical analysis, *Hydrologic models, *Model studies, Mathematical equations, Mathematical studies, Discharge coefficient, Discharge hydrographs, Runoff, Flow discharge.

The performance of a hydrological model is usually assessed first by visual inspection of the measured and computed hydrographs. Numerous statistical criteria are available for numerical evaluation of model accuracy in each single year, in a particular season of the year, or in a sequence of years or seasons. In the last case, the problem of computing the overall results has to be considered. If too many criteria are used and the criteria are switched frequently, an assessment of a mode's performance becomes difficult for a potential user. Therefore, this study concentrates on just three criteria and their combined evaluation: (1) the Nash-Sutcliffe coefficient (R super 2), which compares the model computed discharge with the average measured discharge; (2) the 'coefficient of gain from daily means' (DG) in which a uniform average discharge is replaced by daily average discharges; and (3) the volumetric difference between the total measured and computed runoff (D sub v). The three criteria were combined in a three dimensional representation that allows intercomparisons of model performance in a single diagram. Some simple recommendations can be made. When calculating R super r2, the use of average measured discharge (Q) from the same season or year being simulated as opposed to a long-term average is preferred when extreme seasons or years are evaluated. When averaging R super 2 over several seasons or years, use a simple arithmetic average should be used. DG is a valuable statistic to compute because it is a measure of what is gained by using a particular model instead of the daily mean discharges (or a 'peasant's model'). D sub v is a valuable supplement to visual inspection of hydrographs, and D sub v can be combined with R super 2 and DG to produce a three-dimensional representation of model performance in a single diagram. (Lantz-PTT)
W89-11805

ELECTROMAGNETIC DATA INTERPRETATION USING MULTIVARIATE LEAST-SQUARES REGRESSION.
Soil Testing Engineers, Inc., Baton Rouge, LA.
G. P. Boutwell, and T. A. Lawrence.
IN: Proceedings of the FOCUS Conference on Eastern Regional Ground Water Issues, September 27-29, 1988, Stamford, Connecticut. National Water Well Association, Dublin, Ohio, 1988. p 3-20, 7 fig, 9 ref.

Descriptors: *Regression analysis, *Geophysics, *Electromagnetic waves, *Data interpretation, *Least squares method, *Multivariate analysis, Statistical analysis, Groundwater pollution, Hydraulic conductivity, Stratigraphy, Geophysics, Plumes, Measuring instruments, Prediction, Quantitative analysis.

In the realm of surface geophysics, electromagnetics (EM) has proven to be an effective and powerful tool. Its popularity in groundwater exploration and contaminant plume delineation has grown considerably in the past few years because it is cost-effective, fast and relatively simple. The most common method of EM data presentation is simple contouring of field data which allows comparisons of conductivity with depth as a function of instrument response. This does not, however, allow stratigraphic definition. A statistical method of EM data interpretation has been developed for use in groundwater studies. A mathematical relationship is developed between a dependent variable such as stratum depth or contaminant concentration, and independent variables, i.e., EM readings taken at known points. Multivariate Least-Squares Regression is used to establish this relationship in an equation which can then be used to predict stratum depth, etc., at other EM survey points. The two major advantages of this method of Multivariate Regression Prediction (MVRP) are: (1) the EM survey serves as an extension of hard data, rather than a method which has to be correlated with additional hard data or another geophysical method; and (2) the results from MVRP are in terms of feet thickness, mg/L concentration, etc., with no further data reduction necessary. Results of various stratigraphic and groundwater studies show that MVRP analysis is an efficient method which produces quantifiable numbers with a high level of confidence. (See also W89-11916) (Lantz-PTT)
W89-11917

PREDICTING NITROGEN CONCENTRATIONS IN GROUND WATER-AN ANALYTICAL MODEL.
IEP, Inc., Sandwich, MA.
For primary bibliographic entry see Field 5B.
W89-11927

HAZARD RANKING: A JOB FOR GEOGRAPHIC INFORMATION SYSTEMS.
Nevada Univ., Las Vegas. Environmental Research Center.
For primary bibliographic entry see Field 5E.
W89-12053

REVIEW AND EVALUATION OF CHEMICAL CONCENTRATION DATA FOR USE IN SUPERFUND PUBLIC HEALTH EVALUATIONS.
ICF-Clement, Washington, DC.
J. M. Vollmerhausen, and B. Turnham.
IN: HWHM 88: Hazardous Wastes and Hazardous Materials. Proceedings of the 5th National Conference held April 19-21, 1988, Las Vegas, Nevada. 1988. p 408-412, 8 tab, 10 ref.

Descriptors: *Data interpretation, *Public health, *Water pollution effects, *Superfund, Hazardous wastes, Chemical analysis, Data acquisition.

Determination of the reliability and validity of chemical concentration data is a critical and often complex first step in performing Superfund public health evaluations. This data review step, which often requires a significant proportion of the total public health evaluation process, is made more complex by laboratory and site-specific problems that interfere with the generation of consistently reliable data. The conditions under which certain types of data are used, including the impacts of their inclusion in the public health evaluation and a detailed evaluation of key elements (e.g., detection limits, blanks and data qualifiers) are examined. In this context, the strengths and limitations of the EPA's chemical data validation process also are reviewed. Through various site examples, some of the more common problems encountered when evaluating data for use in public health evaluations are discussed. Detection limits for specific samples may be higher than actually detected values or may exceed health based criteria and so may confuse the data analysis process. Data qualifiers may indicate uncertainties in either contaminant identify, concentration or both; the use of these qualified data may or may not significantly impact the calculation of health risks associated with reported concentrations. Field, trip, or laboratory blank samples may contain detectable levels of analytes making it difficult to distinguish between contaminant levels which are sit-related and those due to sampling or laboratory contamination. Finally, both the identity and the reported concentration of tentatively identified compounds in various media at a site are questionable. (See also W89-12002) (Lantz-PTT)
W89-12056

SUMMARY OF SELECTED DATA ON CHEMICAL CONTAMINANTS IN TISSUES COLLECTED DURING 1984, 1985, AND 1986.
National Ocean Service, Rockville, MD. Office of Oceanography and Marine Assessment.
For primary bibliographic entry see Field 5B.
W89-12105

RESEARCH, INVESTIGATIONS AND TECHNICAL DEVELOPMENTS: NATIONAL MAPPING PROGRAM, 1985-1986.
Available from Books and Open-File Report Section, USGS, Box 25425, Denver, CO 80225. Open File Report 87-315, 1988. 139p, 41 fig, 2 tab, 116 ref.

Descriptors: *Data acquisition, *Mapping, *Research priorities, Remote sensing, Computers, Cartography, Satellite technology, Geography.

The National Mapping Program of the U.S. Geological Survey is organized into major subject areas of digital cartography, geodetic surveys, image mapping, image processing, remote sensing, and geographic information systems. The application of digital cartographic concepts is leading not only to automated map production, but to the merging analysis of cartographic and other earth science data in digital form-the essence of modern geographic information systems. Several projects are of special interest. These include the Division's MARK II digital system development; production of the GLORIA sonar image atlas of the Exclusive Economic Zone; Global Positioning System activities; the Chernobyl, U.S.S.R., image analysis; the 1:250,000-scale Landstat image map of Denali National Park and Preserve, Alaska and the numerous applications of geographic information systems. (Author's abstract)
W89-12130

8. ENGINEERING WORKS

8A. Structures

HOOD CHARACTERISTICS FOR SIPHON-SHAFT SPILLWAYS.
Istanbul Univ. (Turkey).
N. Agiralioglu, and R. F. Muftuoglu.
Journal of Hydraulic Engineering (ASCE) JHEND8, Vol. 115, No. 5, p 636-649, May 1989. 9 fig, 1 tab, 3 ref, append.

Descriptors: *Spillways, *Siphons, Reservoirs, Hydraulic structures, Hydraulic engineering, Hydraulic design, Measuring instruments.

A siphon-shaft spillway is essentially a shaft spillway furnished with a hood that causes siphonic

operation. The main advantage of a siphon-shaft over a shaft spillway is its capability to reach nearly its maximum discharge capacity under a small head sufficient to start siphonic action, and to maintain nearly full capacity flow until reservoir level falls to the hood-skirt edge elevation. It also enables the reservoir management authority to regulate the water level within the limits set by the crest and the scirt edge. A siphon-shaft spillway model was constructed in the Hydraulic Laboratory of the Technical University of Istanbul. The model consisted of a prismatic tank, a siphon-shaft spillway, and necessary supply, discharge, and measurement devices. An experimental study was conducted to determine the dimensions and shape of the hood for a siphon-shaft spillway consisting of a standard-bellmouth shaft and a hood wholly covering the shaft. Cylindrical hoods of various dimensions were tested in the search for appropriate dimensions and streamlines. The appropriate hood dimensions were determined by evaluating the results regarding the siphonic operation, discharge coefficients, and pressure conditions. The hood design was developed by streamlining the cylindrical hood of selected dimensions. The dimensions and shape of the developed hood seem appropriate and hence its characteristic area ratios A sub gamma/A = 3.7 and A sub delta/A = 3.0, and its shape defined by the dimensionless coordinates are recommended for applications. Dimensionless graphs of discharge coefficient and pressure heads on the crest and hood for the developed hood were developed. (Doria-PTT)
W89-11211

DETENTION POND SIZING FOR MULTIPLE RETURN PERIODS.
Old Dominion Univ., Norfolk, VA. Dept. of Civil Engineering.
A. O. Akan.
Journal of Hydraulic Engineering (ASCE) JHEND8, Vol. 115, No. 5, p 650-664, May 1989. 11 fig, 5 ref.

Descriptors: *Detention reservoirs, *Routing, *Urban runoff, Storage, Flow characteristics, Outlets, Mathematical equations, Mathematical models, Computers, Runoff, Hydrographs.

A desk-top method to size detention ponds and the outlet facilities for multiple return periods is based on the usual reservoir routing technique, which couples the hydrologic storage equation with those describing flow through the outlet structures. The equations are rearranged in terms of several dimensionless parameters. A computer model is employed to solve the governing equations using a finite difference scheme. The results obtained for carefully chosen combinations of the dimensionless parameters are generalized based on the concept of similarity. They are presented in chart form. These charts can be used directly, i.e., without a lengthy trial-and-error routing procedure, to size a detention pond that satisfies a set of design criteria requiring the control of runoff for at least three return periods. The use of the design charts is illustrated through a sample application. (Author's abstract)
W89-11212

DAMS REBORN.
Bureau of Reclamation, Denver, CO.
R. Quint, and W. Fielder.
Civil Engineering CEWRA9, Vol. 59, No. 5, p 44-47, May 1989.

Descriptors: *Dam construction, *Dam rehabilitation, *Dams, *Reservoirs, *Water yield improvement, *Arizona, Reservoir design, Rehabilitation, Bureau of Reclamation, Dam modifications, Drawdown.

Rising water prices in Arizona have necessitated the rehabilitation of dams without draining them. Therefore, the Bureau of Reclamation has plans to rehabilitate Theodore Roosevelt and Stewart Mountain dams without major reservoir drawdowns. The modifications for Theodore Roosevelt Dam include: raising the existing dam 77 ft. to provide both flood control and additional conservation storage; constructing a new steel arch bridge upstream from the dam to remove traffic from the structure; installing a lake tap and a tunnel through the left abutment; replacing the existing 36 MW turbine with a new unit that will fit into the existing scroll case; and adding aesthetics to the modified features. Stewart Mountain Dam located three dams downstream from Theodore Roosevelt Dam, will be stabilized, an auxiliary spillway will be built, and the existing power penstock, river outlet works and spillway will all be modified. Because of the inner-dependencies of all the dams, proper construction sequencing for the Theodore Roosevelt Dam and Stewart Mountain Dam is imperative. Therefore, the modification at Stewart Mountain Dam will be completed prior to the partial reservoir drawdown and major construction of Theodore Roosevelt Dam. (White-Reimer-PTT)
W89-11456

RISK ASSESSMENT OF EXTREME EVENTS: APPLICATION.
McKinsey and Co., Inc., Stockholm (Sweden).
P. O. Karlsson, and Y. Y. Haimes.
Journal of Water Resources Planning and Management (ASCE) JWRMD5, Vol. 115, No. 3, p 299-320, May 1989. 12 fig, 8 tab, 15 ref. National Science Foundation Grant No. ECE85-13445 and Oak Ridge National Laboratory/Environmental Systems Management, Inc. Contract No. 41X-56529V.

Descriptors: *Risk assessment, *Dam stability, *Dam construction, *Safety, *Structural engineering, Risk analysis, Statistical methods, Hydrologic data, Cost analysis, Probabilistic process, Optimization, Dam stability, Flood damage, Annual floods.

The safety of many existing dams could be improved by modifying them structurally in accordance with recent advances in statistical hydrology and improved availability of meteorological and hydrological data. Any increase in safety that might be gained by structural changes must be balanced against their costs. The risk analysis methodology known as the partitioned multiobjective risk method (PMRM) is explored in this paper through a dam-safety problem. The PMRM is well suited to the task of solving the probabilistic optimization problem posed by such risk-versus-cost considerations. With the PMRM, a number of conditional expected-damage functions are generated. Of these, one that represents events of a more extreme and catastrophic character is of particular interest here. The close relationship that exists between the expectation of damage and the statistics of extremes is shown to simplify the implementation of the PMRM, and the relationship also permits the derivation of closed-form equations that determine (for any partitioning of the probability axis) the expected damage, given that a flood with a return period that equals or exceeds a specific number of years occurs. Finally, an analysis is made as to how the choice of the distribution function representing the annual flood peaks might affect the conditional expectations. (Author's abstract)
W89-11598

AUTOMATED DESIGN OF WASTEWATER PLANTS.
Municipality of Metropolitan Seattle-METRO, WA.
For primary bibliographic entry see Field 5D.
W89-11645

RATING SYSTEM FOR THE CONCRETE IN NAVIGATION LOCK MONOLITHS,
For primary bibliographic entry see Field 8F.
W89-11892

DUTCH GULCH OUTLET WORKS, COTTONWOOD CREEK, CALIFORNIA.
Army Engineer Waterways Experiment Station, Vicksburg, MS. Hydraulics Lab.
W. G. Davis.
Available from the National Technical Information Service, Springfield, VA 22161 as ADA-208037, Price codes: A04 in paper copy, A01 in microfiche. Technical Report HL-89-5, April 1989. Final Report. 60p, 3 fig, 5 tab, 8 photos, 30 plates.

Descriptors: *California, *Intakes, *Stilling basins, *Hydraulic structures, *Outlets, *Hydraulic models, *Model studies, *Flood control, *Regulated flow, *Energy dissipation, Conduits, Reservoir releases, Flow profiles, Hydrodynamics, Flow discharge.

The intake structure of the proposed Dutch Gulch Dam will provide effective regulation of both flood control and water quality releases. The model investigation of the outlet works for the proposed structure was concerned with verification and improvement of the hydraulic design of the intake structure, conduit, and stilling basin. The study was conducted in a 1:25-scale model of the outlet works, which reproduced a portion of the approach area, the intake structure, the outlet conduit, the hydraulic jump type stilling basin, and approximately 400 ft of exit channel. Pressure flow occurred in the turbine exit chamber for turbine releases > 600 cu ft/sec (cfs). Enlarging the exit chamber portal and streamlining the portal invert should result in greater turbine releases under partial flow conditions. The conduit experienced slug flow for a wide range of flood control discharges, which created surges in the stilling basin and exit channel. The conduit was vented, resulting in a significant reduction of the range of discharges for which slug flow occurred. Pressures were positive throughout the intake structure for all discharges observed. Performance of the original design exit channel was inadequate, resulting in significantly higher tailwaters than expected. As a result of model tests, changes were made in the design of the exit channel to pass the desired discharges. The stilling basin baffle piers were also modified. Performance of the type 2 design exit channel and stilling basin provided adequate energy dissipation and flow conditions for all discharges (excluding slug flow) observed. (Author's abstract)
W89-11894

INSPECTION OF THE ENGINEERING CONDITION OF UNDERWATER CONCRETE STRUCTURES.
Drexel Univ., Philadelphia, PA.
S. Popovics, and W. E. McDonald.
Available from the National Technical Information Service, Springfield, VA 22161. Technical Report REMR-CS-9, April 1989. Final Report. 81p, 10 fig, 3 tab, 48 ref, 4 append.

Descriptors: *Underwater, *Hydraulic structures, *Maintenance, *Concrete construction, *Inspection, *Civil engineering, Design standards, Stability analysis, Safety.

All civil works structures must be continually evaluated for structural safety, stability, and operational adequacy. This is particularly true for underwater structures partially because it is more difficult to establish existing damages than it is for structures above the water; and partially because the underwater failure of many structures, such as dams, can produce very serious loss of lives and property. The overall objectives of this report is to present organized information essential to the evaluation and monitoring of the engineering condition needed for continued safety of underwater civil works structures. Specific objectives are: (a) to summarize the typical types of deterioration that occur in underwater concrete structures; (b) to provide engineering guidelines for inspecting the condition of underwater structures; and, (c) to provide guidelines for interpreting inspection data. As recommended in the report, the inspection and evaluation of the engineering condition of underwater structure are presented by a comprehensive review of the design of the structure and the construction techniques and materials used as well as its operation and maintenance history. Information is obtained from available engineering data on the structure and from onsite investigation. This report summarizes these activities, pertinent inspection procedures and techniques, and methods of evaluation used by the Corps of Engineers and the US Army Engineer Waterways Experiment

Station. Methods and procedures that were developed by other agencies and individuals for the evaluation of concrete civil works structures are also included. Standardized and other methods that have proven satisfactory for inspection are emphasized. Methods that have potential for detection of the extent and cause of inadequacies in underwater concrete structures are also included. (Author's abstract)
W89-11905

AIR-LIFT DEVELOPMENT SYSTEM FOR DEEP WELLS,
Dunn Geoscience Corp., Albany, NY.
W. O. Howard, T. V. Danahy, and M. Ianniello.
IN: Proceedings of the FOCUS Conference on Eastern Regional Ground Water Issues, September 27-29, 1988, Stamford, Connecticut. National Water Well Association, Dublin, Ohio, 1988. p 559-564, 1 fig.

Descriptors: *Deep wells, *Water supply development, *Wells, *Drilling, *Observation wells, *Water quality control, Construction methods, Costs, Pipes, Dewatering, Monitoring, Aquifers, Bedrock, Air-lift development system, Compressed air, Formation water, Filtration.

During a geohydrologic investigation of volatile organic contamination, five deep (100-200 ft) bedrock wells were installed. An air-lift system, designed for developing deep groundwater monitoring wells was selected for the well development. The system included enough threaded sections of 5 ft by 1 in. schedule 40 PVC pipe and 1/2-in. polyethylene tubing to reach the bottom of each well, a double check valve that threads onto the base of the PVC pipe, an air compressor that is capable of generating at least 100 CFM at 100 pounds/sq in and an air coalescer unit that filters the compressed air before it is injected into the system. Compressed air was injected through the polyethylene tubing into the PVC pipe, evacuating the water within it. The double check valve system at the base of the PVC pipe prevents the compressed air from entering the well precluding any introduction of air into formational groundwater. Upon evacuation, more groundwater immediately entered the PVC pipe through the check valves until equilibrium with the static water level was reached. Repeating this cycle allowed for discharge rates of over 1 gallon per minute (gpm). The capability of this system to rapidly remove large quantities of groundwater from the deep wells made this an effective and efficient method which can be used in both overburden and bedrock wells. By being an enclosed air-lift system, the advantages of using this system over a conventional air-lift system are numerous. This system overcomes the risk of transmitting contaminants into the well and surrounding aquifer. The system prevents the injection of large quantities of compressed air which could possibly alter the groundwater chemistry. In addition, overburden monitoring wells and bedrock wells that have been installed with a screen and gravel pack are susceptible to serious damage (ie., blowing out sandpacks) as a result of conventional air-lift methods. This risk is prevented by using this type of enclosed air-lift system. Finally, this system is much more effective at containing discharging groundwater than is a conventional air-lift system. (See also W89-11916) (Lantz-PTT)
W89-11947

NAVIGATION CONDITIONS AT GALLIPOLIS LOCKS AND DAM, OHIO RIVER: HYDRAULIC MODEL INVESTIGATION.
Army Engineer Waterways Experiment Station, Vicksburg, MS. Hydraulics Lab.
L. J. Shows, and R. T. Wooley.
Available from the National Technical Information Service, Springfield, VA 22161. Technical Report HL-89-10, May 1989. Final Report. 199p, 25 fig, 8 tab, 50 photos, 69 plates.

Descriptors: *Navigable rivers, *Dams, *Navigation, *Locks, *Ohio River, *Hydraulic models, Model studies, Gates, Canal construction, Gallipolis Locks and Dam, Alternative planning.

Gallipolis Locks and Dam, located on the Ohio River approximately 279.2 miles below Pittsburgh, PA, is one of the original 46 locks and dams provided for navigation. The capacity of the existing locks and their approaches are inadequate for present and projected traffic. Alternatives considered for the improvement of conditions included the construction of either one 1,200-ft lock, one 1,200-ft lock and a 600-ft lock, or two 1,200-ft locks in a canal bypassing the existing structure, with and without the use of the existing locks with some improvements; and a complete replacement structure with two 1,200-ft locks about 3 miles downstream. Two fixed-bed models constructed to scales of 1:120 were used to study navigation conditions at the existing site and at the replacement site. The model studies indicated that conditions at the existing site would continue to be difficult and hazardous for downbound tows using the existing locks although some improvements could be made. Satisfactory navigation conditions could be developed with one or two locks in the bypass canal at the existing site, and provisions could be made for two-way traffic under most conditions with two locks in the bypass canal. Navigation conditions for downbound tows approaching the locks with the replacement structure (alternate site) would tend to be difficult and hazardous with the plan as originally proposed because of the alignment and high velocity of currents approaching the locks. A satisfactory plan was developed by shifting the structures downstream, rearranging the lock auxiliary walls, and modifying the excavation of the adjacent (right) bank. (Author's abstract)
W89-11993

ENVIRONMENTAL ASPECTS OF RIGHTS-OF-WAY FOR NATURAL GAS TRANSMISSION PIPELINES: AN UPDATED BIBLIOGRAPHY.
Argonne National Lab., IL. Energy and Environmental Systems Div.
For primary bibliographic entry see Field 4C.
W89-12092

8B. Hydraulics

MODELS OF DAM-BREAK FLOW IN R-T SPACE.
University of Strathclyde, Glasgow (Scotland). Dept. of Civil Engineering.
J. M. Townson, and A. H. Al-Salihi.
Journal of Hydraulic Engineering (ASCE) JHEND8, Vol. 115, No. 5, p 561-575, May 1989. 11 fig, 28 ref, append.

Descriptors: *Streamflow forecasting, *Flood waves, *Floods, *Model studies, *Dam failure, *Mathematical models, Flow, Reservoirs, Safety, Shallow water, Model testing, Simulation, Channels, Hydraulic engineering.

The method of characteristics is applied to numerical integration of the shallow water equations written in r-t coordinates. Instant failure of a dam, between vertical walls which either converge or diverge, is then simulated. Comparisons are made with the Ritter and Stoker solutions for parallel walls and different initial depths downstream, including the associated positive surge. Physical model test results confirm general expectations that converging walls create deeper and faster flows downstream and vice versa. Composite wall arrangements are tested, and comparison also is made with the simulation of dam-break flow in a contracting channel by Marshall and Menendez. (Author's abstract)
W89-11207

VELOCITY DISTRIBUTION IN OPEN CHANNEL FLOW.
Pittsburgh Univ., PA. Dept. of Civil Engineering.
C.-L. Chiu.
Journal of Hydraulic Engineering (ASCE) JHEND8, Vol. 115, No. 5, p 576-594, May 1989. 8 fig, 11 ref, append.

Descriptors: *Open-channel flow, *Velocity distribution, Mathematical equations, Estimating equations, Probabilistic process, Entropy, Hydrodynamics, Open channels, Flow, Simulation, Hydraulics.

Velocity distribution equations for open channel flows are derived and compared. These equations are derived by a combined application of: (1) A probabilistic formulation of the velocity distribution problem; (2) the entropy concept in the selection of the probability distribution function of velocity; (3) a geometrical technique in modeling a curvilinear coordinate and the coordinate transformation between this and the Cartesian coordinates; and (4) the basic hydrodynamics concerning the rates of transport of mass, momentum, and kinetic energy by the flow through an open channel cross section. A technique to estimate the parameters of these velocity distribution equations is also developed. The equations are capable of modeling and simulating the velocity distribution from the channel bed to the water surface, which may have the maximum velocity occurring on or below the water surface. (Author's abstract)
W89-11208

SUPERCRITICAL FLOW IN CHANNEL JUNCTIONS.
Ecole Polytechnique Federale de Lausanne (Switzerland). Dept. de Genie Civil.
W. H. Hager.
Journal of Hydraulic Engineering (ASCE) JHEND8, Vol. 115, No. 5, p 595-616, May 1989. 18 fig, 2 tab, 12 ref, 5 append.

Descriptors: *Open-channel flow, *Supercritical flow, *Rapid flow, *Channels, Waves, Hydraulics, Flow characteristics, Momentum equation, Hydraulic engineering.

Using both a theoretical and an experimental approach, the main flow features in junctions with thoroughly supercritical flows are considered. The junctions are characterized by rectangular channels of equal branch width and sharp-edged corners. Junction angles of 22.5 and 45 degrees are considered. Expressions are given for the direction of the main wave front, and the wave angles in both the upstream and the lateral branches. The prediction is based on a conventional cross-wave analysis, in which streamline curvature effects were not incorporated. Yet, reasonable agreement is found between predictions and observations regarding the maximum wave height and its position in the junction. Furthermore, the velocity field and the flow surface are discussed for typical flow configurations. Finally, the limits of thoroughly supercritical flow conditions are verified by the momentum equation, thereby including the flow contraction generated at the inflow to the downstream branch. The prediction gave reliable results if the flow depths in the upstream and the lateral branches are of the same order. (Doria-PTT)
W89-11209

EXPERIMENTS IN SIDE-CHANNEL SPILLWAYS.
Ecole Polytechnique Federale de Lausanne (Switzerland). Dept. de Genie Civil.
R. Bremen, and W. H. Hager.
Journal of Hydraulic Engineering (ASCE) JHEND8, Vol. 115, No. 5, p 617-635, May 1989. 15 fig, 8 tab, 14 ref, 2 append.

Descriptors: *Side-channel spillways, *Spillways, *Channels, *Flow characteristics, Hydraulic jump, Tranquil flow, Profiles, Prediction, Hydraulics.

Results of experimental observations in rectangular side-channel spillways are presented, with particular attention to the effects of a nonprismatic cross section and the bottom slope on the free surface profile. For subcritical flow, the difference of surface profiles along the channel axis and the side walls is outlined. Further, flow configurations with supercritical inflow conditions and the possible formation of hydraulic jumps along the lateral inflow length are discussed. The observations are compared with predictions based on an extended theoretical approach, thereby including the streamwise momentum contribution due to the lateral flow. The agreement between the computed and

the observed axial free surface profile is fair. The proposed extended model equation should be considered whenever the bottom slope of the side channel is larger than a certain percentage. (Author's abstract)
W89-11210

HOOD CHARACTERISTICS FOR SIPHON-SHAFT SPILLWAYS.
Istanbul Univ. (Turkey).
For primary bibliographic entry see Field 8A.
W89-11211

HYDRAULIC JUMP IN U-SHAPED CHANNEL.
Ecole Polytechnique Federale de Lausanne (Switzerland). Dept. de Genie Civil.
W. H. Hager.
Journal of Hydraulic Engineering (ASCE) JHEND8, Vol. 115, No. 5, p 667-675, May 1989. 7 fig, 1 tab, 7 ref, append.

Descriptors: *Open-channel flow, *Hydraulic jump, *Channel morphology, Conduits, Mathematical analysis, Velocity distribution, Profiles, Flow characteristics, Flow pattern, Hydraulics, Stilling basins.

Hydraulic jumps in circular conduits flowing partially full have received only minor attention. Lane and Kindsvater have collected data that led to partially or completely filled tail water conditions. Their computed sequent depths ratio slightly overestimated observations. Silvester reported similar results. Rajaratnam pointed at the formation of lateral wings at the toe of the jump. Also, Rajaratnam analyzed hydraulic jumps in exponential and circular cross sections but did not present any experimental data. The only observations in circular conduits flowing partially full are due to Kunstatsky and Vybora. However, neither experimental details nor basic data are presented. Some basic aspects of hydraulic jumps in circular conduits running partially full are clarified. To allow easy access to the flow, a U-shaped channel was used instead of a circular conduit. Regarding the sequent depths ratio, small differences between flows in U-shaped and circular channels are found. Several types of surface profiles are discussed. The most interesting results pertain to the internal jump phenomena. For small relative inflow depth a distinct bottom separation appears. Several flow zones are described and typical axial velocity distributions are presented. The application of the peculiarity to stilling basins of short protected bottom length is discussed. For larger relative inflow depth, the flow resembles hydraulic jumps in a rectangular channel. (Doria-PTT)
W89-11213

ASSESSING THE VALIDITY OF THE CHANNEL MODEL OF FRACTURE APERTURE UNDER FIELD CONDITIONS.
Geological Survey, Reston, VA.
For primary bibliographic entry see Field 2F.
W89-11252

WAVE GROUPING EFFECT IN IRREGULAR WAVE AGITATION IN HARBORS.
Laval Univ., Quebec. Dept. of Civil Engineering.
Y. Ouellet, and I. Theriault.
Journal of Waterway, Port, Coastal and Ocean Engineering (ASCE) JWPED4, Vol. 115, No. 3, p 363-383, 1989. 11 fig, 4 tab, 26 ref. National Science and Engineering Research Council of Canada Grant A7099.

Descriptors: *Hydraulic properties, *Wave action, *Hydraulic models, *Harbors, Reflection, Diffraction, Wave refraction.

Hydraulic model tests were conducted on two different natural harbors to study the influence of diffraction and reflection of irregular waves compared to regular waves. Two types of reflective walls within one harbor were also tested. Irregular wave trains with different peak frequencies and groupiness factors were generated. These tests have shown that within the limits of the frequency band of the spectral energy density, irregular wave diffraction-reflection coefficients show less variability and appear to give better information than do the ones obtained from regular wave tests. Outside the frequency range containing most of the energy of the incident wave train, high values of the transfer function were observed in the lower and upper frequency range. However, their energy content was relatively small, and the long wave energy attached to wave grouping could not be attributed to harbor resonance. In the high frequency range, the presence of noise is attributed to the high transfer function estimates. (Author's abstract)
W89-11473

DUTCH GULCH OUTLET WORKS, COTTONWOOD CREEK, CALIFORNIA.
Army Engineer Waterways Experiment Station, Vicksburg, MS. Hydraulics Lab.
For primary bibliographic entry see Field 8A.
W89-11894

NEWPORT NEWS CHANNEL DEEPENING STUDY, VIRGINIA: NUMERICAL MODEL INVESTIGATION.
Army Engineer Waterways Experiment Station, Vicksburg, MS. Hydraulics Lab.
H. C. Lin, and W. D. Martin.
Available from the National Technical Information Service, Springfield, VA 22161. Technical Report HL-89-12, June 1989. Final Report. 56p, 5 fig, 1 tab, 22 plates, 7 ref, append.

Descriptors: *Model studies, *Channel improvement, *Newport News Channel, *Mathematical models, *Sedimentation, *Virginia, *Water circulation, *Tidal currents, Hydrodynamics, Estuaries, Finite element method, James River, Hampton Roads, Tidal flats, Eddies, Sediment transport, Flow velocity, Shoals.

This report presents results from a numerical model investigation whose primary objective was to evaluate general changes in circulation, currents, and sedimentation associated with the over-deepening of the Newport News Channel. An additional objective of the study was to assess the effects of the over-deepening on the reported estuarine circulation cell (flow convergence) off Hampton Flats and Newport News Point. Three alternative plans of over-deepening, 57, 64, and 70 ft, were evaluated. This investigation used the TABS-2 finite element numerical models RMA-2V for hydrodynamic analysis and STUDH for sediment transport computation with a modified version of an existing numerical mesh (expansion plan B) of the Lower James River. Results from the numerical hydrodynamic modeling indicated no velocity increases in the Willoughby Bay area. The maximum velocity change identified in the Hampton Flats are was < 0.1 ft/sec during the maximum flood tide. The maximum velocity change in the channel was 0.2 ft/sec. No circulation changes were identified in the base-to-plan comparison of velocity vector plots. Additionally, no change in tidal phasing or water-surface elevation was detected. The formation and location of the two-dimensional circulation cell off Newport News Point were unaffected by any of the plans. Results from the sedimentation modeling showed that a maximum decrease in shoaling in the Hampton Flats are was about 7%, a maximum increase in shoaling in the Newport News Channel was $<$ 1%, and a maximum increase in shoaling in the Willoughby Bay areas was about 6%. (Lantz-PTT)
W89-11904

APPLIED HYDRAULIC TRANSIENTS.
Washington State Univ., Pullman. Dept. of Civil and Environmental Engineering.
M. H. Chaudhry.
Second edition. Van Nostrand Reinhold Co., New York. 1987. 521p.

Descriptors: *Hydraulics, *Hydraulic transients, *Hydraulic design, Water conveyance, Mathematical studies, Hydrodynamics, Turbines, Hydraulic machinery, Cooling water, Mathematical equations, Case studies.

This volume explains the most recent methods of analysis for solving hydraulic transient problems, focusing on practical applications in hydroelectric power plants, water supply systems, oil pipelines, open channels, and cooling water systems. Almost all important aspects of hydraulic transients are covered, starting with basic principles and definitions. Fully explained are: waterhammer analysis; resonance in pressurized piping systems; elimination of undesirable transients; analysis of surge tanks using a lumped-system approach; transients caused by turbines and centrifugal pumps; and transients in cooling water systems, in oil pipelines, and in open channels. New areas fully explained are: explicit and implicit finite difference schemes; cooling water systems; governed hydraulic turbines; and derivation of governing equations using the Reynolds transport theorem. In addition, new information is included on: pump turbines, closed surge tanks, hydraulic turbine governors, and on recent advances in numerical methods. Case studies of actual projects and up-to-date references are included. (Lantz-PTT)
W89-11998

HYDRAULIC CHARACTERISTICS OF MODEL SOIL-BENTONITE SLURRY CUTOFF WALLS.
Cincinnati Univ., OH. Dept. of Civil and Environmental Engineering.
For primary bibliographic entry see Field 5G.
W89-12028

INLET HYDRAULICS AT GREEN HARBOR, MARSHFIELD, MASSACHUSETTS.
Coastal Engineering Research Center, Vicksburg, MS.
L. L. Weishar, and D. G. Aubrey.
Available from the National Technical Information Service, Springfield, VA 22161, as AD-A198 196. Price codes: A10 in paper copy, A01 in microfiche. Miscellaneous Paper CERC-88-10, July 1988. Final Report. 133p, 44 fig, 16 tab, 85 plates, 20 ref, 3 append.

Descriptors: *Massachusetts, *Wave refraction, *Harbors, *Channel accretion, *Sediment transport, *Inlets, *Tidal hydraulics, Waves, Erosion, Jetties, Riprap, Vegetation, Shoals, Green Harbor, Hydraulics.

A combination office study, field data collection, and numerical model study was used to determine the principal causes of shoaling at Green Harbor, MA. Results of a year-long data collection effort which obtained directional wave information offshore of the harbor entrance revealed that the harbor is subjected to waves of over 12-sec periods. Results of the wave refraction study and sediment transport calculation formed the basis of the sediment budget which identified the major sediment sources for each of the shoals within the tidal inlet system. The following recommendations are made: (1) reduce the west jetty lee side fillet which is partially responsible for building of the entrance shoal through dredging; (2) raise the elevation and tighten the east jetty to minimize wave overtopping during storms; (3) eliminate or reduce the length differential between the east and west jetties; (4) riprap the east Narrows to reduce erosion and sediment transport in the interjetty region; and (5) implement a beach grass planting program, augmented with sand fencing, for the dune region adjacent to Green Harbor Beach. The combination of beach grass and sand fencing should minimize the quantities of sand transported into the interjetty region by aeolian processes. (Lantz-PTT)
W89-12106

8C. Hydraulic Machinery

OPTIMAL SEQUENCING OF DEVELOPMENT FOR HYDROPOWER STATIONS IN CASCADE.
Wuhan Inst. of Hydraulic and Electric Power Engineering (China).
Y. Wan, S. Huang, and M. A. Marino.
Journal of Water Resources Planning and Management (ASCE) JWRMD5, Vol. 115, No. 3, p 379-395, May 1989. 4 fig, 2 tab, 7 ref.

Descriptors: *Hydroelectric plants, *Water resources development, *Thermal powerplants, *Powerplants, *Cost-benefit analysis, Mathematical models, Model studies, Comprehensive planning, Timing, China.

The sequencing problem for hydropower station development is a multidimensional problem involving space-time decisions. A mathematical model that uses a combination of dynamic programming and mixed-integer programming is developed, and an efficient algorithm for its use in optimal sequencing problems is presented. The dynamic-programming submodel (DPM) generates the alternative possible combinations of hydropower and thermal power stations (i.e., states) and analyzes the different sequences of hydropower station development. The mixed-integer programming submodel (MIPM) simulates the operation of the power system and determines the minimum fuel-cost operating policy. The MIPM requires an auxiliary flow regulation submodel (FRM). The combined use of the DPM, MIPM, and the FRM provides investment and operation decisions in one run. Therefore, the optimal development sequence of the hydropower stations and the timing of installation of power-generating units in each station are obtained from the solution of the DPM-MIPM-FRM model. This model is applied to the preliminary planning of hydropower stations on the Wujiang River in the southwestern region of China, and the results are described. (Author's abstract)
W89-11603

AUTOMATED DESIGN OF WASTEWATER PLANTS.
Municipality of Metropolitan Seattle-METRO, WA.
For primary bibliographic entry see Field 5D.
W89-11645

MITIGATION, COMPENSATION, AND FUTURE PROTECTION FOR FISH POPULATIONS AFFECTED BY HYDROPOWER DEVELOPMENT IN THE UPPER COLUMBIA SYSTEM, MONTANA, U.S.A.
Montana Dept. of Fish, Wildlife and Parks, Kalispell.
For primary bibliographic entry see Field 8I.
W89-11693

SEASONAL VARIATION IN THE COMPOSITION OF THE DRIFT BELOW A PEAKING HYDROELETRIC PROJECT.
Tennessee Cooperative Fishery Research Unit, Cookeville.
For primary bibliographic entry see Field 6G.
W89-11695

INSTREAM FLOW PREDICTIONS AND MANAGEMENT OPTIONS FOR BIOTA AFFECTED BY PEAKING-POWER HYDROELECTRIC OPERATIONS.
Tulsa Univ., OK. Faculty of Biological Science.
For primary bibliographic entry see Field 6G.
W89-11696

REHABILITATION OF CROW DAM GATE TOWER.
Bureau of Reclamation, Denver, CO.
R. V. Todd.
The Repair, Evaluation, Maintenance, and Rehabilitation Research Program Information Exchange Bulletin, Vol. 6, No. 2, May 1989. p6-10, 3 fig, 4 ref.

Descriptors: *Hydraulic machinery, *Mechanical failure, *Gates, *Maintenance, Welding, Materials testing, Concretes, Montana, Irrigation, Deterioration, Slide gates, Cylindrical gates, Construction materials, Design criteria, Materials engineering, Mechanical engineering, Structural engineering, Cost analysis.

Crow Dam, located approximately 7 miles southeast of Ronan, Montana, was completed in 1933. The shaft of the concrete gate tower is 94 ft high; it contains two 6-ft-diameter by 3-ft high cast-iron cylinder gates, which are used for making releases for irrigation. At partial openings, fluctuating hydraulic loads act on the bottom of the gates and through the gate stems to the top of the gate tower. Resulting displacements of the gates and stems have caused failures of the gates, stems, and guides. Because of the overall deterioration of the gate tower and the associated mechanical equipment, a rehabilitation program was required. Two rehabilitation options were considered: (1) replacement of the cylinder gates with slide gates; and (b) reconstruction of the cylinder gate system and restoration of the damaged areas of the gate tower. The original cylinder gates, guide brackets, stem guides, and stem guide bases were made of gray cast iron. Initially, the decision was to replace these parts with castings similar to the original ones. However, when the specifications were put out for bids in 1985, there was no response. The specifications were then amended to give the contractor the option of using weldments or castings. This change resulted in a number of bids, all quoting the weldment option. In changing the method of fabrication from a casting to a weldment, adjustments had to be made in the entire gate structure, to compensate for the inherent fatigue-proneness of a welded structure. This change from iron casting to welding, adjustment of seat rings, and concrete repairs on the inner surface of the tower with epoxy, brought to light a number of areas that should be considered when an old structure needs to be rehabilitated: manufacturing processes change with time, and improved technologies make some processes obsolete or no longer cost-effective; the availability and types of materials also change with time--procuring materials called for in the original design may not be possible; original methods of obtaining certain operational requirements may not be practical under the rehabilitation conditions; and repairing materials and equipment instead of replacing them may be practical and considerably less expensive. (Lantz-PTT)
W89-11879

8D. Soil Mechanics

GLACIATED COASTS.
Boston Univ., MA. Dept. of Geology.
For primary bibliographic entry see Field 2J.
W89-12118

8E. Rock Mechanics and Geology

IDENTIFYING FRACTURE INTERCONNECTIONS BETWEEN BOREHOLES USING NATURAL TEMPERATURE PROFILING: I. CONCEPTUAL BASIS.
Notre Dame Univ., IN. Dept. of Civil Engineering.
For primary bibliographic entry see Field 2F.
W89-11282

STORAGE OF HEATED WATER IN UNDERGROUND OPENINGS.
Ehime Univ., Matsuyama (Japan). Dept. of Civil Engineering.
Y. Inada, and R. L. Sterling.
Journal of Geotechnical Engineering (ASCE) JGENDZ, Vol. 115, No. 5, p 597-614, May 1989. 16 fig, 2 tab, 8 ref, append.

Descriptors: *Rock properties, *Underground storage, *Heated water, *Temperature effects, *Cavern flow, Compressive strength, Strength, Young's modulus, Poisson ratio, Thermal expansion, Diffusivity, Wetting, Numerical analysis, Stress analysis.

A study was carried out to determine the effects of storage water at elevated temperatures on the rock surrounding a storage cavern. Properties of granite and andesite are then measured at temperatures between 15 and 100 degrees Centigrade determined in laboratory experiments. The rock properties measured are compressive strength, tensile strength, tangential Young's modulus, Poisson's ratio, coefficient of thermal expansion, and thermal diffusivity. Results are determined for rock specimens prepared in both a dry and a wet condition. In general, the rock properties are adversely affected by moisture and by an increase in temperature. The effect of an increase in temperature is more significant in the wet-rock specimens. The experimental rock properties determined were used in a numerical analysis to determine the effect of the storage of heated water at a temperature of 100 degrees Centigrade in a 10-meter-diameter circular underground opening at a depth of 100 meters below the ground surface. For the conditions analyzed, the results indicated that rock surrounding the opening would not be overstressed. (Author's abstract)
W89-11595

GEOMORPHOLOGY OF A TECTONICALLY ACTIVE, GLACIATED COAST, SOUTH-CENTRAL ALASKA.
Maryland Univ., Cambridge. Horn Point Environmental Labs.
L. G. Ward, T. F. Moslow, and K. Finkelstein.
IN: Glaciated Coasts. Academic Press, Inc, New York. 1987. p 1-31, 14 fig, 1 tab, 30 ref.

Descriptors: *Coasts, *Geomorphology, *Tectonics, *Alaska, *Glaciation, Fjords, Coastal waters, Sediments, Deltas, Tidal flats, Bedrock, Geologic formations, Mountains, Bays, Islands.

Significant variations in the coastal geomorphology of the predominantly bedrock shoreline from Lower Cook Inlet to Prince William Sound, Alaska, occur due to crustal movements (submergence versus emergence), glaciations, and wave energy. In areas that underwent submergence during the Good Friday, 1964, earthquake, the coastline is dominated by steep bedrock slopes with extremely narrow intertidal zones. The primary depositional features associated with these bedrock coasts are relatively steep, coarse-grained talus fan beaches or pocket beaches. Conversely, areas uplifted during the 1964 earthquake have wider intertidal zones, with wave-cut platforms being common. Also, depositional features occur more frequently along emergent shorelines with linear, sand to boulder beaches and talus fan beaches dominating. Bedrock shorelines exposed to the Gulf of Alaska, which has one of the most severe wave climates in the world, are actively undergoing erosion. River valley and glacial outwash fan deltas occur along both submergent and emergent shorelines where sediment supply is abundant (usually glacially derived). Lobate fan deltas with relatively large tidal flat deposits dominate in low-wave-energy environments. Conversely, where wave energy is high, the fan deltas are arcuate-cupsate in shape with beach ridge plains and recurved spits occurring frequently. The morphologic characteristics of beach environments vary according to sediment texture and exposure to wave energy. Sediments comprising the beaches range from fine sand to boulders, although modes occur in the medium sand and pebble range. Coarses grained beaches tend to be narrower and steeper than finer grained beaches. Beach slope also decreases with increasing wave energy. On the basis of the geomorphic and sedimentologic processes observed in the study area, four principle types of coastal units are delineated: (1) mountainous coastline; (2) fjord coastline; (3) exposed embayment coastline; and (4) linear island coastline. (See also W89-12118) (Author's abstract)
W89-12119

8F. Concrete

IN SITU REPAIR OF DETERIORATED CONCRETE.
Army Engineer Waterways Experiment Station, Vicksburg, MS. Structures Lab.
J. E. McDonald.
The Repair, Evaluation, Maintenance, and Rehabilitation Research Program Information Exchange Bulletin, Vol. 6, No. 2, May 1989. p1-5, 6 fig.

Descriptors: *Deterioration, *Cracks, *Concrete technology, *Maintenance, *Concretes, *Hydrau-

lic structures, *Epoxy resins, Strength, Dams, Polymers, Dam failure, Materials testing, Adhesives, Resins, On-site tests, Performance evaluation, Field tests, Radial gates, Piers, Ultrasonics, Freeze-thaw tests, Concrete testing, Comparison studies.

Repair of concrete in hydraulic structures generally involves removing the deteriorated concrete and replacing it with new, cast-in-place concrete. To develop alternatives to concrete removal and replacement, a study was initiated to evaluate in situ repair procedures. Of the repair techniques identified as being applicable to in situ repair, the pressure injection technique was selected for detailed laboratory evaluation. Eight injection adhesives were experimentally evaluated to determine their effectiveness in the repair of cracks in air-dried and water-saturated concrete. The adhesives were three epoxies, an emulsifiable polyester resin, furfuryl alcohol, a furan resin, a high molecular weight (HMW) methacrylate, and a polyurethane. The effectiveness of the repairs was evaluated by ultrasonic pulse velocity measurements before and after injection, visual examination of cores removed from each slab, and splitting tensile strength tests on the cores. Results of these evaluations indicated that each of the adhesives can restore the structural integrity of concrete containing air-dried and water-saturated cracks. However, the most promising adhesive was Denepox 40, a two-component, very low viscosity epoxy system designed specifically for pressure injection repairs. Once the adhesive was selected, the next step was to optimize the repair procedures and to evaluate equipment to be used in the small-scale field test. With the exception of several cracks in two cores, all of the cracks appeared to be completely filled with epoxy. Results of splitting tensile strength tests ranged from 340 to 815 pounds per square inch (psi) and averaged 610 psi, compared with 545 psi for the control. A field test was performed on a tainter gate pier stem at Dam No. 20, Mississippi River. Tests conducted on discs cut from two cores with partially filled cracks indicated that the average splitting tensile strength had decreased from 565 to 390 psi after 100 cycles of freezing and thawing. The splitting tensile strength of the core with no visible epoxy had decreased from 4345 to 80 psi after 100 cycles. In spite of the reductions in the pulse velocities and splitting tensile strengths of the cores with partially filled cracks, the concrete appeared to be in good condition, with only minor surface scaling and no deterioration around cracks. (Lantz-PTT)
W89-11878

RATING SYSTEM FOR THE CONCRETE IN NAVIGATION LOCK MONOLITHS,
R. E. Bullock.
Available from the National Technical Information Service, Springfield, VA 22161 as ADA-208 304, Price codes: A05 in paper copy, A01 in microfiche. Army Corp of Engineers Technical Report REMR-OM-4, May 1989. Final Report. 80p, 6 fig, 2 tab, 3 append. Department of the Army Contract DACA39-87-M-0744.

Descriptors: *Concrete technology, *Navigation, *Locks, *Hydraulic structures, *Concrete construction, Classification, Cracks, Maintenance, Mechanical failure, Deterioration.

The purpose of this report is to describe a proposed system for determining a condition index (CI) that numerically rates the condition of the concrete in a lock monolith on a scale of 0 to 100 by evaluating each concrete deficiency. The rating system described here allows the CI to be determined by the use of a visual investigation with limited equipment. The rating is related primarily to structural integrity and secondarily to serviceability. The CI procedure was developed by assigning specific deduct values to defects which include the following distress categories: alignment, cracking, volume loss, steel deterioration, and leakage and deposits. The deduct values are subtracted from 100 to establish the CI. Primary deduct values were determined with the intent of obtaining a CI of zero when deterioration of a concrete monolith caused the safety of that monolith to become critical. Nominal deduct values were assigned for defects in serviceability. Deduct values for distress categories that tend to result in loss of concrete from the structure (volume), and thus effective weight and cross section, were assigned by making approximations concerning safety and assuming: (a) all sections were cracked so that no tension or cohesion existed at the section; and (b) the total force tending to producing sliding or total moment tending to produce overturning was constant. The CI should be determined on all gate monoliths, on at least one of each of the remaining types of monoliths, and on the more distressed monoliths. It is recommended that a minimum of 10% of the monoliths be rated. (Author's abstract)
W89-11892

IN SITU REPAIR OF DETERIORATED CONCRETE IN HYDRAULIC STRUCTURES: A FIELD STUDY.
Brookhaven National Lab., Upton, NY. Dept. of Applied Science.
For primary bibliographic entry see Field 8G.
W89-11999

RISK ASSESSMENT FOR HAZARDOUS MATERIALS CONTAINMENT STRUCTURE.
Texas Univ. at San Antonio.
For primary bibliographic entry see Field 5E.
W89-12055

8G. Materials

IN SITU REPAIR OF DETERIORATED CONCRETE.
Army Engineer Waterways Experiment Station, Vicksburg, MS. Structures Lab.
For primary bibliographic entry see Field 8F.
W89-11878

IN SITU REPAIR OF DETERIORATED CONCRETE IN HYDRAULIC STRUCTURES: A FIELD STUDY.
Brookhaven National Lab., Upton, NY. Dept. of Applied Science.
R. P. Webster, L. E. Kukacka, and D. Elling.
Available from the National Technical Information Service, Springfield, VA 22161. Technical Report REMR-CS-21, April 1989. Final Report. 65p, 26 fig, 5 tab, 8 ref, 2 append.

Descriptors: *Deterioration, *Concrete technology, *Hydraulic structures, *Maintenance, *Epoxy resins, *Materials testing, Concrete dams, Field tests, Case studies, Economic aspects, Cracks, Mississippi River, Missouri, Injection, Cores, Freeze-thaw tests, Cost analysis.

This report presents the results of a laboratory program directed toward developing and optimizing procedures for pressure injection repairs to be used in the field. Once developed, the procedures were evaluated in a small-scale field test at Lock and Dam 20 on the Mississippi River, Canton, Missouri. The objectives of the field test were to demonstrate, under field conditions, the procedures developed in the laboratory and to evaluate the effectiveness of the materials and equipment selected for use. The repair work on Pier No. 27 was limited to the top 4.2-ft of the pier stem, or that portion located above the archway ceiling of the walk-through area. The deterioration in this area was characterized by two major cracks that extended from the top of the pier stem down to the ceiling of the archway. Also, a network of cracks was visible on the upstream and downstream faces of the pier stem. Approximately 5 gallons of Denepox 40 epoxy was injected into the top of the pier stem over a period of 2 days. A number of problems were encountered during injection, but the job, in general, was a success. A visual examination of three cores taken from Pier No. 27 after completion of the injection repair work indicated that 80% to 90% of the crack network within these cores appeared to be filled with epoxy. Tests to evaluate the resistance of repaired cores to deterioration due to cycles of freezing and thawing indicated at 26% decrease in the pulse velocity values and a 31% decrease in the splitting tensile strength after being subjected to 100 cycles. An economic analysis of the repair procedure projects that the most of repairing the top 4.2-ft of a pier stem by epoxy injection varies between $24,535 for repairing 1 pier stem to $85,630 for repairing 10. (Lantz-PTT)
W89-11999

CHEMICAL COMPATIBILITY TESTING OF GEOSYNTHETICS TO BE USED AS CONTAINMENT BARRIERS IN HAZARDOUS WASTE MANAGEMENT.
Texas Research Inst., Inc., Austin.
K. Verschoor, L. Britton, and R. Thomas.
IN: HWHM 88: Hazardous Wastes and Hazardous Materials. Proceedings of the 5th National Conference held April 19-21, 1988, Las Vegas, Nevada. 1988. p 205-209, 9 fig.

Descriptors: *Waste disposal, *Materials testing, *Geosynthetic materials, *Barriers, *Hazardous wastes, *Waste management, Polymers, Chemical analysis.

Polymeric lining materials (geomembranes) currently are being used as the critical barrier in the containment of hazardous and toxic solid waste materials. Non-woven, polymeric fibrous geotextiles are used as cushioning layer on top of the geomembrane. Geotextiles are also used as porous wicking agents in conjunction with polymeric geogrids as leachate collection systems in the design of active effluent control situations. Regulatory agencies are requiring landfill management to provide results of chemical compatability testing on geosynthetic materials to be used in the sequestering of hazardous waste. The chemical compatibility test procedures currently established by the US EPA are outlined in EPA Method 9090. This method measures changes in physical properties after exposure to leachates at ambient and elevated temperatures. Physical property testing offers a method to characterize the strength and serviceability of these materials; however, it does not help to elucidate any changes that may be occurring at the polymer level. Modern thermal analysis techniques can be used to study changes that occur in the polymer as a function of temperature. Differential scanning calorimetry can give an accurate measure of a polymer's crystallinity which then can be correlated with the polymer's resistance to chemical permeation. Studies indicate that thermal mechanical analysis can accurately measure subtle changes in the polymer's properties that can't be detected with traditional physical property measurements. Additional compatibility testing can be performed to assess the serviceability and durability of geosynthetics used as barriers. Liners can be characterized in terms of their resistance to chemical permeation. Initial studies show that some chemicals permeate through liner materials at a molecular level. (See also W89-12002) (Author's abstract)
W89-12030

8I. Fisheries Engineering

HABITAT SELECTION OF LENTIC LARVAL LAMPREYS: PRELIMINARY ANALYSIS BASED ON RESEARCH WITH A MANNED SUBMERSIBLE.
Michigan State Univ., East Lansing. Dept. of Zoology.
For primary bibliographic entry see Field 2H.
W89-11194

ASSESSMENT OF LAKE TROUT SPAWNING HABITAT QUALITY IN CENTRAL LAKE HURON BY SUBMARINE.
National Fisheries Research Center-Great Lakes, Ann Arbor, MI.
B. A. Manny, and T. A. Edsall.
Journal of Great Lakes Research JGLRDE, Vol. 15, No. 1, p 164-173, 1989. 4 fig, 4 tab, 41 ref.

Descriptors: *Limnology, *Lake fisheries, *Trout, *Spawning, *Lake Huron, *Submarines, Biochemical oxygen demand, Dissolved oxygen, Aquatic

habitats, Interstitial water, Ammonia, Hydrogen sulfide, Fish eggs, Great Lakes, Water quality, Thermal stratification, Chlorophyll, Silica, Particulate matter, Algae.

Interstitial water quality was measured using the submersible Johnson-Link II at seven locations on Six Fathom Bank in Lake Huron. Waters overlying Six Fathom Bank were thermally stratified at 10-15 m. Dissolved oxygen concentrations were at or above 100% saturation at all depths. Chlorophyll, suspended particulate matter, and silica concentrations were typical of those found in oligotrophic waters. Periphyton growing on limestone rocks on the bank consisted of an 'overstory' of large filamentous algae (Cladaphora sp., Melosira sp.) occurring in macroscopic tufts up to 2 cm long, and a relatively uniform 'understory' of microscopic algae (possibly Gomontia sp. or Gongrosira sp., and Oscillatoria sp.) inhabiting the crystaline lattice of the rock surface to a depth of 0.5-1.0 mm. Both Cladophora filaments of the overstory and the lattice understory were colonized by a wide variety of microscopic (3 microns wide, up to 20 microns long), epiphytic algae including Oscillatoria sp. and numerous centric and pennate diatoms. Historically, the bank was an important lake trout spawning ground. It is currently the focus of coordinated, interagency efforts to rehabilitate lake trout in Lake Huron. Water quality, evaluated from measurements of biochemical oxygen demand, dissolved oxygen, ammonia, and hydrogen sulfide among the rocks, would not prevent lake trout eggs from hatching successfully on the bank. (Sand-PTT)
W89-11195

REPLICATION AND TREATMENT STRENGTH IN WHOLE-LAKE EXPERIMENTS.
Wisconsin Univ.-Madison. Center for Limnology.
For primary bibliographic entry see Field 2H.
W89-11371

CONTRIBUTION OF SEASONALLY FLOODED LANDS AND MINOR TRIBUTARIES TO THE PRODUCTION OF COHO SALMON IN CARNATION CREEK, BRITISH COLUMBIA.
Department of Fisheries and Oceans, Nanaimo (British Columbia). Fisheries Research Branch.
For primary bibliographic entry see Field 2H.
W89-11396

EFFECT OF SALINITY ON FREE AMINO ACIDS IN THE PRAWN PALAEMON ELEGANS (RATHKE),
Innsbruck Univ. (Austria). Inst. fuer Zoologie.
G. D. Via.
Archiv fuer Hydrobiologie AHYBA4, Vol. 115, No. 1, p 125-135, March 1989. 10 fig, 1 tab, 16 ref. Fonds zur Forderung der wissinschaftlichen Forschung in Osterreich project 3307 and Osterreichische Nationalbank project 1208.

Descriptors: *Salinity, *Physiological ecology, *Shrimp, *Amino acids, Osmotic pressure, Osmotic shock, Crustaceans, Saline water, Hydrolysis, Proteins.

The concentration of free amino acids (FAA) in Palaemon elegans were measured following 48 hours of exposure to different hypoosmotic and hyperosmotic salinity stresses. A linear decrease in total FAA with decreasing salinity was found. The FAA with the highest concentrations in seawater-adapted P. elegans are glycine (51%), taurine (19%), proline (11%), arginine (6%), and alanine (4%). After a hypoosmotic shock from 40 to 10 ppt glycine, taurine, proline, and alanine lower the total FAA pool by 44%, whereas arginine, aspartate, glutamate, and methionine are not affected by environmental salinity. Below about 20 ppt most FAA concentrations remain more or less constant and intracellular volume is regulated by proline and glycine only. Hyperosmotic shock results in a concentration increase of nearly all FAA. Between 40 ppt to 45 ppt the essential FAA (not including arginine) increase by 55% indicating protein hydrolysis. (Author's abstract)
W89-11447

MAKING AMENDS WITH NATURE.
H. Smallowitz.
Civil Engineering CEWRA9, Vol. 59, No. 5, p 56-59, May 1989.

Descriptors: *Stream fisheries, *Fish barriers, *Fish conservation, *Fish passages, Water management, Northwest Power Planning Council, Dams, Economic aspects, Costs, Umatilla River, Yakima River, Columbia River, Water supply.

A decade ago Congress, in a move to bring back the fish, passed the Northwest Power Act authorizing Idaho, Montana, Oregon, and Washington to form the Northwest Power Planning Council (NPCC) to develop ways to improve fish and wildlife stocks in the basin. Currently the plan is costing about $100 million a year; most of that money is coming from the Bonneville Power Administration (BPA). A complex agreement has been negotiated to spill water over the dams in the basin in order to safely wash young fish through the dams to the sea, rather than forcing them to travel the more treacherous route through the turbines. Other measures being investigated include: raising the emergency headgates on dams; and lengthening the submerged screens that shunt the fish away from the turbines. Work is already proceeding on the Yakima River where rotating drum screens and adult fish passages at all diversions along the river are being replaced. However, water quantity is also a problem, due in part to irrigated agriculture in the area. In the Umatilla Basin the problem is similar to that of the Yakima; how to provide adequate water for fish without taking it from man. Plans are currently underway to pump water from the Columbia River for agricultural use in order to maintain water supplies in the Umatilla River. (White-Reimer-PTT)
W89-11459

LOWER LETHAL TEMPERATURES FOR CARP (CYPRINUS CARPIO L.) AND THE PHYTOPHAGOUS FISHES (CTENOPHARYNGODON IDELLA VAL., HYPOPHTHALMICHTHYS MOLITRIX VAL., ARISTICHTHYS NOBILIS RICH.) IN THE FIRST PERIOD OF LIFE (DOLNE LETALNE TEMPERATURY DLA KARPIA (CYPRINUS CARPIO) I RYB ROSLINOZERNYCH (CTENOPHARYNGODON IDELLA VAL., HYPOPHTHALMICHTHYS MOLITRIX VAL., ARISTICHTHYS NOBILIS RICH.) W PIERWSZYM OKRESIE ZYCIA).
Instytut Rybactwa Srodladowego, Olsztyn-Kortowo (Poland).
For primary bibliographic entry see Field 2H.
W89-11494

UPPER LETHAL TEMPERATURES FOR CARP (CYPRINUS CARPIO L.) AND THE PHYTOPHAGOUS FISHES (CTENOPHARYNGODON IDELLA VAL., HYPOPHTHALMICHTHYS MOLITRIX VAL., ARISTICHTHYS NOBILIS RICH.) IN THE FIRST PERIOD OF LIFE (GORNE LETALNE TEMPERATURY DLA KARPIA (CYPRINUS CARPIO L.) I RYB ROSLINOZERNYCH (CTENOPHARYNGODON IDELLA VAL., HYPOPHTHALMICHTHYS MOLITRIX VAL., ARISTICHTHYS NOBILIS RICH.) W PIERWSZYM OKRESIE ZYCIA).
Instytut Rybactwa Srodladowego, Olsztyn-Kortowo (Poland).
For primary bibliographic entry see Field 2H.
W89-11495

THRESHOLD OXYGEN CONTENT IN WATER FOR JUVENILE STAGES OF THE CYPRINIDS (CTENOPHARYNGODON IDELLA VAL., HYPOPHTHALMICHTHYS MOLITRIX VAL., ARISTICHTHYS NOBILIS RICH., CYPRINUS CARPIO L.) (PROGOWA ZAWARTOSC TLENU W WODZIE DLA MLODOCIANYCH STADIOW RYB KARPIOWATYCH (CTENOPHARYNGODON IDELLA VAL., HYPOPHTHALMICHTHYS MOLITRIX VAL., ARISTICHTHYS NOBILIS RICH., CYPRINUS CARPIO L.)).
Instytut Rybactwa Srodladowego, Olsztyn-Kortowo (Poland).
For primary bibliographic entry see Field 2H.
W89-11496

REARING OF GRASS CARP LARVAE (CTENOPHARYNGODON IDELLA VAL.) IN PONDS RECEIVING HEATED EFFLUENTS: I. SCHEME OF THE EXPERIMENT, TEMPERATURE, WATER FLOW IN THE PONDS AND FISH PRODUCTION (PODCHOW WYLEGU AMURA BIALEGO (CTENOPHARYNGODON IDELLA VAL.) W STAWACH ZASILANYCH WODA PODGRZANA: I. SCHEMAT EKSPERYMENTU, TEMPERATURA I PRZEPLYW WODY W STAWACH ORAZ WYNIKI RYBACKIE).
Instytut Rybactwa Srodladowego, Olsztyn-Kortowo (Poland).
G. Okoniewska, W. Piotrowska-Opuszynska, and K. Opuszynski.
Roczniki Nauk Rolniczych, Seria H: Rybactwo RNRRB9, Vol. 101, No. 4, p 111-127, 1988. 6 fig, 2 tab, 28 ref. English summary.

Descriptors: *Fish management, *Fish ponds, *Temperature effects, *Survival, *Growth, Fish, Powerplants, Fertilizers, Fish stocking, Manure, Water temperature, Heated water.

Experiments were carried out for 21 days on the rearing of grass carp larvae in the ponds receiving heated effluents from a power plant. Water flow in the ponds and level of fertilization were differentiated. Water temperature in the ponds depended on water flow and air temperature. Temperature of the inflowing water varied from 24.6 to 29.4 C. Average water temperature in the ponds with flowing water amounted to 20.5 C in the morning and 22 C in the evening. In the ponds with no water flow, the temperature was lower by about 2 C on the average. In the ponds with no water flow, the individual fish weight amounted to 205.9 mg on the average, and the fish length to 25.0 mm after 21 days of rearing, at 2% survival. In the ponds with flowing warm water, the respective values amounted to 362.6 mg, 29.6 mm, and 63%. The results of fish rearing were affected mostly by the temperature, this being conditioned by rate of warm water flow, and less by intensity of fertilization. (See W89-11498 thru W89-11500) (Author's abstract)
W89-11497

REARING OF GRASS CARP LARVAE (CTENOPHARYNGODON IDELLA VAL.) IN PONDS RECEIVING HEATED EFFLUENTS: II. PHYSICO-CHEMICAL CONDITIONS (PODCHOW WYLEGU AMURA BIALEGO (CTENOPHARYNGODON IDELLA VAL.) W STAWACH ZASILANYCH WODA PODGRZANA: II. WARUNKI FIZYCZNO-CHEMICZNE).
Instytut Rybactwa Srodladowego, Olsztyn-Kortowo (Poland).
W. Piotrowska-Opuszynska, H. Skrzydlo, and K. Opuszynski.
Roczniki Nauk Rolniczych, Seria H: Rybactwo RNRRB9, Vol. 101, No. 4, p 129-148, 1988. 8 fig, 1 tab, 26 ref. English summary.

Descriptors: *Fish management, *Carp, *Temperature effects, *Fish ponds, Fish, Powerplants, Heated water, Flow, Fertilizers, Chlorophyll a, Primary productivity, Nitrogen, Phosphorus, Nutrients, Manure.

Studies were carried out on the effect of water heating and flow in the ponds, and different fertilization upon the conditions for grass carp rearing. Studies were carried out in the ponds receiving heated effluents from a power plant in Poland. The water flow affected the phytoplankton most of all. In the heated ponds, biomass of the phytoplankton was much lower than in ponds with no water flow, dropping to trace levels by the end of the experiment. However, primary production in relation to the algae biomass was proportionally higher in the ponds with water flow. Heated ponds were also characterized by low destruction, and high net production. Oxygen conditions were initially slightly worse in the heated ponds with water flow, becoming more and more unfavorable along

with the decrease of phytoplankton. Nutrient content in water of the ponds under study depended on three factors: reeding impact of algae (most of all), fertilization (mostly in case of phosphorus), and water flow. Additional fertilization with manure had a negligible effect on the environmental conditions. (See W89-11497 and W89-11499 thru W89-11500) (Author's abstract)
W89-11498

REARING OF GRASS CARP LARVAE (CTENOPHARYNGODON IDELLA VAL.) IN PONDS RECEIVING HEATED EFFLUENTS: III. FOOD CONDITIONS (PODCHOW WYLEGU AMURA BIALEGO (CTENOPHARYNGODON IDELLA VAL.) W STAWACH ZASILANYCH WODA PODGRZANA: III. WARUNKI POKARMOWE).
Instytut Rybactwa Srodladowego, Olsztyn-Kortowo (Poland).
For primary bibliographic entry see Field 3C.
W89-11499

REARING OF GRASS CARP LARVAE (CTENOPHARYNGODON IDELLA VAL.) IN PONDS RECEIVING HEATED EFFLUENTS: IV. FOOD (PODCHOW WYLEGU AMURA BIALEGO (CTENOPHARYNGODON IDELLA VAL.) W STAWACH ZASILANYCH WODA PODGRZANA: IV. POKARM).
Instytut Rybactwa Srodladowego, Olsztyn-Kortowo (Poland).
For primary bibliographic entry see Field 3C.
W89-11500

RESULTS ON EXPLORATORY FISHING SURVEY IN SALTO GRANDE RESERVOIR (RESULTADOS DE LA PROSPECCION PESQUERA EN EL EMBALSE DE SALTO GRANDE).
Instituto Nacional de Investigacion y Desarrollo Pesquero, Mar del Plata (Argentina).
L. B. Prenski, and C. Baigun.
Rivista de Investigacion y Desarollo Pesquero, Vol. 6, No. , p 77-102, 1986. 21 fig, 10 tab, 33 ref. English summary.

Descriptors: *Fish harvest, *Reservoir fisheries, *Argentina, Fishing gear, Mesh size, Temperature, Water level, Distribution, Postimpoundment.

An exploratory fishing survey and appraisal in Salto Grande Reservoir was performed the first year after impoundment. Samples were taken bimonthly at six sampling stations located in different regions of the lake, using a standard gang of gill nets. The fishing effort in each station was one night and the results are expressed in terms of catch per unit effort (CPUE). A survey of the species present, vulnerable to the gears used, was made for the exploitable species taking into account their distribution according to the mesh size and the proportion of fish at commercial size. The catch in the areas studied were compared giving a mean value of the catch per unit effort for the whole reservoir, on the other hand, environmental factors such as temperature and water level are considered in order to examine their probable influence on the catch per unit effort value obtained. (Author's abstract)
W89-11609

JOINT ACTION OF AMMONIA AND NITRITE ON ARTEMIA NAUPLII.
National Taiwan Coll. of Marine Science and Technology, Keelung. Dept. of Aquaculture.
For primary bibliographic entry see Field 5C.
W89-11644

MITIGATION, COMPENSATION, AND FUTURE PROTECTION FOR FISH POPULATIONS AFFECTED BY HYDROPOWER DEVELOPMENT IN THE UPPER COLUMBIA SYSTEM, MONTANA, U.S.A.
Montana Dept. of Fish, Wildlife and Parks, Kalispell.
J. Fraley, B. Marotz, J. Decker-Hess, W. Beattie, and R. Zubik.
Regulated Rivers Research and Management RRRMEP, Vol. 3, No. 1-4, p 3-18, Jan-Apr 1989. 3 fig, 4 tab, 28 ref.

Descriptors: *Hydroelectric power, *Fish conservation, *Fish management, *Fish populations, *Dam effects, *Montana, *Columbia River, Reservoir operation, Fish migration, River flows, Trout, Salmon, Plankton.

The construction of Hungry Horse Dam resulted in estimated annual losses of 65,500 migratory juvenile westslope cutthroat and 1965 adult migratory bull trout from the Flathead Lake and River system. In addition, operations of Hungry Horse and Kerr dams caused annual losses conservatively estimated at 96,300 river-spawning and 131,000 lakeshore-spawning kokanee adults. Water level fluctuations caused by dam operations at Libby and Hungry Horse reservoirs result in: (1) altered thermal stratification; (2) indirect losses in phytoplankton and zooplankton production, (3) direct washout of phytoplankton and zooplankton through dam penstocks; (4) reductions in standing crop of benthic organisms and of insects on the water surface; and (5) reduced fish growth in the late summer and fall. Mitigative measures include: (1) 99.2 and 113.3 cu m/s minimum flows in the Flathead and Kootenai rivers respectively, to protect salmonid eggs and juveniles; (2) improvement of fish passage to restore migrations between the Flathead and Swan systems; and (3) biological rule curves for operations at Libby and Hungry Horse reservoirs. To compensate for fisheries losses, enhancement of spawning and rearing habitat, introductions of hatchery juveniles, and spawning channels are recommended. In addition, protection from further hydropower development for 100 stream reaches for fish species of special concern, and for outstanding sport fisheries is recommended. These and other measures will be considered by various agencies in developing an overall fisheries restoration plan which should be flexible, and employ principles of adaptive management. (Author's abstract)
W89-11693

PREDICTION OF REGULATION EFFECTS ON NATURAL BIOLOGICAL RHYTHMS IN SOUTH-CENTRAL AFRICAN FRESHWATER FISH.
J.L.B. Smith Inst. of Ichthyology, Grahamstown (South Africa).
For primary bibliographic entry see Field 6G.
W89-11710

REMOVAL OF BROWN TROUT (SALMO TRUTTA L.): CHANGES IN POPULATION DYNAMICS IN A WEIR BASIN IN WESTERN NORWAY.
Bergen Univ. (Norway). Zoological Museum.
G. G. Raddum, A. Fjellheim, and H. Saegrov.
Regulated Rivers Research and Management RRRMEP, Vol. 3, No. 1-4, p 225-233, Jan-Apr 1989. 6 fig, 2 tab, 24 ref.

Descriptors: *Weirs, *Regulated flow, *Stream fisheries, *Trout, *Fish management, *Norway, Fish populations, Reservoirs, Population density, Immature growth stage, Dominance.

The trout population in a 10.6 ha weir basin in western Norway has been studied over thirteen years. Baseline investigations were carried out during 1974-78, three to five years after construction of the weir. Studies in 1983 showed that the 1977 and 1978 year-classes were dominant. This dominance lasted until 1985. Removal of 75 per cent of the population for stocking in reservoirs reduced the fish biomass from 1.43 to 0.28 kg/100 sq m. This increased the growth rate and condition factor of the remaining fish in subsequent years. The trout enter the basin mainly at age 2+ and 3+. No increase in the number of immigrants was observed during the first two years after removal of fish. In the third year; however, a five-fold increase was measured. Most of these fish belonged to the 1985 year-class, which had little contact with the strong classes of 1977 and 1978. It was concluded that density-dependent factors control immigration to the basin, whereas a combination of density-dependent and independent factors act on the recruitment in the riffle areas. It is suggested that the highest recruitment of fish is obtained by reducing the density-dependent effect through removing a very high proportion of the young fish, 2+ and 3+ every year. (Author's abstract)
W89-11712

EXPLOITATION RATE, SURVIVAL AND MOVEMENTS OF BROWN TROUT (SALMO TRUTTA L.) STOCKED AT TAKEABLE SIZE IN THE REGULATED RIVERS LAGEN AND OTTA, SOUTHERN NORWAY.
Environmental Division, Statsetatenes hus, N-2600 Lillehammer, Norway.
For primary bibliographic entry see Field 2H.
W89-11714

EFFECTS OF RIVER REGULATION ON THE STRUCTURE OF A FAST-GROWING BROWN TROUT (SALMO TRUTTA L.) POPULATION.
Oslo Univ. (Norway). Zoological Museum.
For primary bibliographic entry see Field 6G.
W89-11715

FLUSHING FLOW RECOMMENDATIONS FOR MAINTENANCE OF SALMONID SPAWNING GRAVELS IN A STEEP, REGULATED STREAM.
EA Engineering, Science, and Technology, Inc., Lafayette, CA.
D. W. Reiser, M. P. Ramey, S. Beck, T. R. Lambert, and R. E. Geary.
Regulated Rivers Research and Management RRRMEP, Vol. 3, No. 1-4, p 267-275, Jan-Apr 1989. 5 fig, 10 ref.

Descriptors: *Regulated flow, *Anadromous fish, *Fish behavior, *Fish management, *Spawning, *California, *Flushing, *Gravel, Salmon, Stream discharge, Regulated rivers, Sediment transport.

A study was conducted to develop flushing flow recommendations for maintaining the quantity of salmonid spawning gravels in the North Fork of the Feather River, a regulated stream in California. This required the development of a technique which would prescribe flows to remove sediments from the gravels without removing the gravels themselves, which are in finite supply in the river. Field studies involved the use of a 'two-point-arc' procedure which allowed depth, velocity, and substrate measurements to be concentrated over spawning gravels at each site. Measurements were repeated at each site at three different flows ranging from 1.7 to 11.3 cu m/s. The local velocity and depth measurements were used to evaluate hydraulic conditions within areas containing spawning gravels. Four flow levels were derived which would provide varying degrees of sediment transport and flushing; (1) surficial flushing of gravels; (2) mobilization of gravels; (3) surficial flushing of cobbles; and (4) mobilization of cobbles. Results of the study indicated a flushing flow of 56.6 cu m/s occurring as a planned release or natural flow for from 1-3 days would be sufficient to transport sediment from spawning gravels. This flow was intermediate to levels which maximize surficial gravel flushing and levels which maximize surficial cobble flushing. (Author's abstract)
W89-11716

ABILITY OF PHABSIM TO PREDICT CHINOOK SALMON SPAWNING HABITAT.
Department of Fisheries and Oceans, Nanaimo (British Columbia). Pacific Biological Station.
C. S. Shirvell.
Regulated Rivers Research and Management RRRMEP, Vol. 3, No. 1-4, p 277-289, Jan-Apr 1989. 5 fig, 3 tab, 22 ref.

Descriptors: *Simulation analysis, *Aquatic habitats, *Fish behavior, *Stream biota, *Model studies, *Spawning, *Salmon, British Columbia, Prediction, Neyhako River, Instream flow, River mechanics.

PHABSIM (Physical HABitat SIMulation), part of the Instream Flow Incremental Methodology, was

used to predict the spawning habitat used by chinook salmon in a 600 m long section of the Nechako River, British Columbia, Canada. Predictions of the model were compared to the location and amount of habitat actually used by adult chinook salmon in 1974, 1980, and 1986. About 3800 sq m (70 per cent) of the spawning area actually used by the population were predicted as unusable by the 'best' prediction, while 87 per cent of the area predicted as usable has never had recorded use. The 'best' prediction resulted from using close transect spacing, frequent measurements along the transect, river-specific habitat suitability criteria, and modelling habitat at the fish's position near the stream bottom. Depending upon the spacing of the transects and the habitat suitability criteria used, PHABSIM predicted 210 per cent to 660 per cent more spawning habitat was available than historically had ever been used. Chinook salmon in the Nechako River spawn mainly on the upstream face of dunes, therefore, the assumption in PHABSIM that conditions predicted at the transects remain unchanged upstream and downstream part way to the adjacent transects was false. This assumption resulted in about two-thirds of the correct predictions being made for the wrong reason. The accuracy of PHABSIM's predictions for spawning might be improved by incorporating an index of river bottom topography or velocity gradient into the model. (Author's abstract)
W89-11717

DEVELOPMENT OF HABITAT SUITABILITY CRITERIA FOR TROUT IN SMALL STREAMS.
Pacific Gas and Electric Co., San Ramon, CA.
For primary bibliographic entry see Field 2H.
W89-11718

SEDIMENT TRANSPORT AND RESULTING DEPOSITION IN SPAWNING GRAVELS, NORTH COASTAL CALIFORNIA.
Pacific Southwest Forest and Range Experiment Station, Arcata, CA.
For primary bibliographic entry see Field 2J.
W89-11771

ACIDIFICATION OF NATIVE BROOK TROUT STREAMS IN VIRGINIA.
Virginia Univ., Charlottesville. Dept. of Environmental Sciences.
For primary bibliographic entry see Field 5B.
W89-11776

DETACHED CHLOROPHYTES AS NURSERY AREAS FOR FISH IN SULAIBIKHAT BAY, KUWAIT.
Kuwait Univ., Safat. Dept. of Zoology.
J. M. Wright.
Estuarine, Coastal and Shelf Science ECSSD3, Vol. 28, No. 2, p 185-193, February 1989. 5 fig, 2 tab, 17 ref. Kuwait University grant SZ027.

Descriptors: *Spawning, *Aquatic habitats, *Estuarine fisheries, *Bays, *Kuwait, *Chlorophyta, *Fish, *Eutrophication, Nurseries, Juvenile growth stage, Amphipods.

The role of accumulations of detached chlorophytes as temporary nursery areas are described for the fish assemblage of Sulaibikhat Bay (Kuwait). The chlorophytes were produced during the spring bloom in the intertidal and near sublittoral. The accumulations in the shallow near shore areas were at a peak during early March. During the time, young of the year of Liza carinata dominated the assemblage in shallow water and these fish were closely associated with the patches of detached chlorophytes, and used them as a physical refuge and as a temporary food resource. In deeper water, where the catches were dominated by mature Leiognathus brevirostris. the numbers of which were dominated by mature Leignathus brevirostris, the numbers of which were related to the volume of weed are the beginning of the bloom but not toward the end of the bloom. Although L. brevirostris appeared not to use the weed as a refuge this species utilized the weed as a temporary food resource. During the study, there was no evidence of weed-associated amphipods being utilized as a food resource. (Author's abstract)
W89-11808

COMPENDIUM OF 45 TROUT STREAM HABITAT DEVELOPMENT EVALUATIONS IN WISCONSIN DURING 1953-1985,
Wisconsin Dept. of Natural Resources, Waupaca. Trout Resource Unit.
For primary bibliographic entry see Field 2H.
W89-12131

9. MANPOWER, GRANTS AND FACILITIES

9C. Research Facilities

NATIONAL RESEARCH PROGRAM OF THE WATER RESOURCES DIVISION, U.S. GEOLOGICAL SURVEY, FISCAL YEAR 1987.
L. C. Friedman, and C. N. Donato.
Available from Books and Open-File Report Section, USGS, Box 25425, Denver, CO 80225. USGS Open-File Report 88-346, 1988. 231p, 7 ref, 2 append.

Descriptors: *Water resources research, *Geohydrology, *Research priorities, *Geochemistry, *Geomorphology, *Sediment transport, *Groundwater movement, Hydrologic properties, Chemical analysis, Bibliographies, Ecology.

The National Research Program (NRP) of the U.S. Geological Survey's Water Resources Division (WRD) encompasses a broad spectrum of scientific investigations. The sciences of hydrology, mathematics, chemistry, physics, biology, geology, and engineering are used to gain a fundamental understanding of the processes that affect the availability, movement, and quality of the Nation's water resources. For technical administration, the NRP is subdivided into six disciplines with a Research Adviser assigned to each. The Research Adviser serves as a peer resource to the research projects and as a technical consultant to management. The six research disciplines are: (1) Ecology, (2) Geochemistry, (3) Geomorphology and Sediment Transport, (4) Groundwater hydrology, (5) Surface-water hydrology and (6) Water chemistry. This report provides current information about the NRP on an annual basis. Organized by the six research disciplines, the volume contains a summary of the problem, objective, approach, and progress for each project that was active during fiscal year (FY) 1987. Bibliographic information is included with each project summary in the form of reports published between April 1986 and May 1987. (Lantz-PTT)
W89-12134

10. SCIENTIFIC AND TECHNICAL INFORMATION

10A. Acquisition And Processing

SAMWAT DATABASE FOR COMPUTER MODELS IN WATER MANAGEMENT.
SAMWAT Report No. 2, September 1988. The Hague, The Netherlands. 1988. 130p. Edited by C. Volp and A. C. W. Lambrechts.

Descriptors: *Computer models, *Water resources management, *Data storage and retrieval, *Databases, Information exchange, Groundwater management, Rainfall-runoff relationships, Model studies, Solute transport, Sediment transport, Sewer systems, Documentation, Agricultural hydrology, Fluid flow, The Netherlands.

The SAMWAT (SAMenworken op het gebied van het onderzoek ten bohoeve van het WATerbeheer) database for water management computer models, the development of which was initiated in the second half of 1987, was designed to include models covering a wide range of different subjects. The design aimed at great flexibility for more modules. The database now consists of modules for groundwater, surface water and sewer systems, rainfall-runoff relations and agricultural production. It can contain a high degree of detail for each model. The modules were developed in close cooperation with specialists in each specific type of research. The development and the extension of the total database with other model modules will be continued in the coming year. Much attention will be given to validation and actualization of the information of the database. The database holds general information relating to the models, such as availability, documentation, kind of computer on which the model is implemented and references on applications. Apart from this general information details are included about all features of the models. The following main characteristics can be distinguished: fluid, solute, heat and sediment transport as well as biological processes, solution methods for basic equations, statistics/stochastics and required boundary conditions. The SAMWAT Bureau can now give detailed answers to all questions concerning water management models of the abovementioned four types available in the Netherlands. (Lantz-PTT)
W89-11992

10C. Secondary Publication And Distribution

WATER SUPPLY AND WASTEWATER DISPOSAL: INTERNATIONAL ALMANAC, VOLUME 1.
For primary bibliographic entry see Field 5F.
W89-11983

WATER SUPPLY AND WASTEWATER DISPOSAL: INTERNATIONAL ALMANAC, VOLUME 2.
For primary bibliographic entry see Field 5F.
W89-11984

WATER SUPPLY AND WASTEWATER DISPOSAL: INTERNATIONAL ALMANAC, VOLUME 3.
For primary bibliographic entry see Field 5F.
W89-11985

WATER SUPPLY AND WASTEWATER DISPOSAL: INTERNATIONAL ALMANAC, VOLUME 4.
For primary bibliographic entry see Field 5F.
W89-11986

WATER SUPPLY AND WASTEWATER DISPOSAL: INTERNATIONAL ALMANAC, VOLUME 5.
For primary bibliographic entry see Field 5F.
W89-11987

WATER SUPPLY AND WASTEWATER DISPOSAL: INTERNATIONAL ALMANAC, VOLUME 6.
For primary bibliographic entry see Field 5F.
W89-11988

WATER SUPPLY AND WASTEWATER DISPOSAL: INTERNATIONAL ALMANAC, VOLUME 7.
For primary bibliographic entry see Field 5F.
W89-11989

WATER SUPPLY AND WASTEWATER DISPOSAL: INTERNATIONAL ALMANAC, VOLUME 8.
For primary bibliographic entry see Field 5F.
W89-11990

WATER SUPPLY AND WASTEWATER DISPOSAL: INTERNATIONAL ALMANAC, VOLUME 9.
For primary bibliographic entry see Field 5F.
W89-11991

ENVIRONMENTAL ASPECTS OF RIGHTS-OF-WAY FOR NATURAL GAS TRANSMISSION PIPELINES: AN UPDATED BIBLIOGRAPHY.
Argonne National Lab., IL. Energy and Environmental Systems Div.
For primary bibliographic entry see Field 4C.
W89-12092

NATIONAL RESEARCH PROGRAM OF THE WATER RESOURCES DIVISION, U.S. GEOLOGICAL SURVEY, FISCAL YEAR 1987.
For primary bibliographic entry see Field 9C.
W89-12134

SEWAGE EFFECTS IN MARINE AND ESTUARINE ENVIRONMENTS, JANUARY, 1977-MARCH, 1988: CITATIONS FROM THE NTIS BIBLIOGRAPHIC DATABASE.
National Technical Information Service, Springfield, VA.
For primary bibliographic entry see Field 5C.
W89-12141

LINERS FOR WASTE DISPOSAL AND WASTE STORAGE FACILITIES, JANUARY 1976-APRIL, 1988: CITATIONS FROM THE ENERGY DATA BASE.
National Technical Information Service, Springfield, VA.
For primary bibliographic entry see Field 5E.
W89-12142

TOXICITY BIOASSAYS: WATER POLLUTION EFFECTS ON AQUATIC ANIMALS AND PLANTS, JUNE 1986-MAY 1988: CITATIONS FROM THE SELECTED WATER RESOURCES ABSTRACTS DATABASE.
National Technical Information Service, Springfield, VA.
For primary bibliographic entry see Field 5C.
W89-12143

SOIL SALINITY: IRRIGATION PRACTICES AND EFFECTS ON CROPS AND GROUND WATER, JANUARY 1977-MAY 1988: CITATIONS FROM THE SELECTED WATER RESOURCES ABSTRACTS DATABASE.
National Technical Information Service, Springfield, VA.
For primary bibliographic entry see Field 5B.
W89-12144

ACID MINE DRAINAGE, OCTOBER 1978-MAY 1988: CITATIONS FROM THE NTIS BIBLIOGRAPHIC DATABASE.
National Technical Information Service, Springfield, VA.
For primary bibliographic entry see Field 5A.
W89-12145

POLYCHLORINATED BIPHENYLS: OCCURRENCE AND TREATMENT IN MUNICIPAL AND INDUSTRIAL WASTES, JANUARY 1977-MAY 1988: CITATIONS FROM THE SELECTED WATER RESOURCES ABSTRACTS DATABASE.
National Technical Information Service, Springfield, VA.
For primary bibliographic entry see Field 5D.
W89-12146

DEEP WELL DISPOSAL, JANUARY 1977-MAY 1988: CITATIONS FROM THE SELECTED WATER RESOURCES ABSTRACTS DATABASE.
National Technical Information Service, Springfield, VA.
For primary bibliographic entry see Field 5E.
W89-12147

METALS RECOVERY FROM WASTES, JUNE 1970-APRIL 1988: CITATIONS FROM THE COMPENDEX DATABASE.
National Technical Information Service, Springfield, VA.
For primary bibliographic entry see Field 5D.
W89-12148

METALS RECOVERY FROM WASTES, JANUARY 1977-APRIL 1988: CITATIONS FROM THE SELECTED WATER RESOURCES ABSTRACTS DATABASE.
National Technical Information Service, Springfield, VA.
For primary bibliographic entry see Field 5D.
W89-12149

SANITARY LANDFALLS, JANUARY 1978-APRIL 1988: CITATIONS FROM THE NTIS BIBLIOGRAPHIC DATABASE.
National Technical Information Service, Springfield, VA.
For primary bibliographic entry see Field 5B.
W89-12150

NUTRIENT REMOVAL FROM LAKES, PONDS, AND RIVERS, JANUARY 1977-JUNE 1988: CITATIONS FROM THE SELECTED WATER RESOURCES ABSTRACTS DATABASE.
National Technical Information Service, Springfield, VA.
For primary bibliographic entry see Field 5G.
W89-12151

PESTICIDE TOXICITY IN FRESHWATER FISH, JANUARY 1978-MAY 1988: CITATIONS FROM THE LIFE SCIENCES COLLECTION DATABASE.
National Technical Information Service, Springfield, VA.
For primary bibliographic entry see Field 5C.
W89-12152

LEACHATE TREATMENT, JANUARY 1972-MARCH 1988: CITATIONS FROM THE POLLUTION ABSTRACTS DATABASE.
National Technical Information Service, Springfield, VA.
For primary bibliographic entry see Field 5G.
W89-12153

ASBESTOS IN DRINKING WATER, JANUARY 1977-MARCH 1988: CITATIONS FROM THE SELECTED WATER RESOURCES ABSTRACTS DATABASE.
National Technical Information Service, Springfield, VA.
For primary bibliographic entry see Field 5F.
W89-12154

DEEP WELL DISPOSAL, JANUARY 1976-MARCH 1988: CITATIONS FROM THE ENERGY DATA BASE.
National Technical Information Service, Springfield, VA.
For primary bibliographic entry see Field 5E.
W89-12155

WASTEWATER TREATMENT, JUNE 1976-MARCH 1988: CITATIONS FROM THE ENERGY DATA BASE.
National Technical Information Service, Springfield, VA.
For primary bibliographic entry see Field 5D.
W89-12156

OIL SPILLS: BIOLOGICAL EFFECTS, JUNE 1981 TO FEBRUARY 1988: CITATIONS FROM THE NTIS BIBLIOGRAPHIC DATABASE.
National Technical Information Service, Springfield, VA.
For primary bibliographic entry see Field 5C.
W89-12157

WASTEWATER TREATMENT: LAGOONS, JANUARY 1977-FEBRUARY 1988: CITATIONS FROM THE SELECTED WATER RESOURCES ABSTRACTS DATABASE.
National Technical Information Service, Springfield, VA.
For primary bibliographic entry see Field 5D.
W89-12158

SEWAGE SLUDGE PRETREATMENT AND DISPOSAL, DECEMBER 1981-FEBRUARY 1988: CITATIONS FROM THE NTIS BIBLIOGRAPHIC DATABASE.
National Technical Information Service, Springfield, VA.
For primary bibliographic entry see Field 5D.
W89-12159

DREDGING: BIOLOGICAL EFFECTS, JANUARY 1979-FEBRUARY 1988: CITATIONS FROM THE NTIS BIBLIOGRAPHIC DATABASE.
National Technical Information Service, Springfield, VA.
For primary bibliographic entry see Field 6G.
W89-12160

HEAVY METALS IN DRINKING WATER: STANDARDS, SOURCES, AND EFFECTS, JANUARY 1977-DECEMBER 1987: CITATIONS FROM THE SELECTED WATER RESOURCES ABSTRACTS DATABASE.
National Technical Information Service, Springfield, VA.
For primary bibliographic entry see Field 5F.
W89-12161

OIL POLLUTION SAMPLING, DETECTION, AND ANALYSIS, JANUARY 1976-JANUARY 1988: CITATIONS FROM THE NTIS BIBLIOGRAPHIC DATABASE.
National Technical Information Service, Springfield, VA.
For primary bibliographic entry see Field 5A.
W89-12162

HEAVY METALS IN DRINKING WATER: STANDARDS, SOURCES, AND EFFECTS, JANUARY 1970-JUNE 1988: CITATIONS FROM THE NTIS BIBLIOGRAPHIC DATABASE.
National Technical Information Service, Springfield, VA.
For primary bibliographic entry see Field 5F.
W89-12163

WASTEWATER TREATMENT: OZONATION PROCESSES AND EQUIPMENT, JANUARY 1977-JULY 1988: CITATIONS FROM THE SELECTED WATER RESOURCES ABSTRACTS DATABASE.
National Technical Information Service, Springfield, VA.
For primary bibliographic entry see Field 5D.
W89-12164

SEWAGE AND INDUSTRIAL WASTE TREATMENT: WETLANDS, JANUARY 1977-JULY 1988: CITATIONS FROM THE SELECTED WATER RESOURCES ABSTRACTS DATABASE.
National Technical Information Service, Springfield, VA.
For primary bibliographic entry see Field 5D.
W89-12165

ACTIVATED CHARCOAL FILTERS: WATER TREATMENT, POLLUTION CONTROL, AND INDUSTRIAL APPLICATIONS, JANUARY 1970-JULY 1988: CITATIONS FROM THE U.S. PATENT BIBLIOGRAPHIC DATABASE.
Ceske Vysoke Uceni Technicke v Praze. Faculty of Civil Engineering and Architecture.
For primary bibliographic entry see Field 5F.
W89-12166

POLYELECTROLYTES: WASTEWATER AND SEWAGE TREATMENT, JANUARY 1977-JUNE 1988: CITATIONS FROM THE SELECTED WATER RESOURCES ABSTRACTS DATABASE.
National Technical Information Service, Springfield, VA.
For primary bibliographic entry see Field 5D.
W89-12167

SLUDGE DEWATERING: SEWAGE AND INDUSTRIAL WASTES, JANUARY 1978-JANUARY 1988: CITATIONS FROM THE POLLUTION ABSTRACTS DATABASE.
National Technical Information Service, Springfield, VA.
For primary bibliographic entry see Field 5E.
W89-12168

POLYCHLORINATED BIPHENYLS: OCCURRENCE IN SEDIMENTS AND SOILS, JANUARY 1977-JANUARY 1988: CITATIONS FROM THE SELECTED WATER RESOURCES ABSTRACTS DATABASE.
National Technical Information Service, Springfield, VA.
For primary bibliographic entry see Field 5B.
W89-12169

POLYCHLORINATED BIPHENYLS IN THE FRESHWATER ENVIRONMENT, JANUARY 1977-JANUARY 1988: CITATIONS FROM THE SELECTED WATER RESOURCES ABSTRACTS DATABASE.
National Technical Information Service, Springfield, VA.
For primary bibliographic entry see Field 5C.
W89-12170

BIODETERIORATION OF OIL SPILLS, JANUARY 1970-JANUARY 1988: CITATIONS FROM THE NTIS BIBLIOGRAPHIC DATABASE.
National Technical Information Service, Springfield, VA.
For primary bibliographic entry see Field 5G.
W89-12171

GROUND WATER POLLUTION: GENERAL STUDIES, DECEMBER 1984-JANUARY 1988: CITATIONS FROM THE NTIS BIBLIOGRAPHIC DATABASE.
National Technical Information Service, Springfield, VA.
For primary bibliographic entry see Field 5B.
W89-12172

10D. Specialized Information Center Services

TERRAIN-BASED WATERSHED INFORMATION SYSTEM,
Toronto Univ. (Ontario). Dept. of Geography.
L. E. Band.
Hydrological Processes HYPRE3, Vol. 3, No. 2, p 151-162, April/June 1989. 7 fig, 2 tab, 15 ref. NASA Grant NAGW-1234.

Descriptors: *Data storage and retrieval, *Watersheds, *Catchment areas, *Topology, *Hydrologic data collections, *Information systems, Drainage area, Parameterization, Runoff, Hydrologic models, Algorithms.

A framework for a watershed information system is presented in which the topology of the drainage basin is closely followed in the data structure. The topography is partitioned into a set of subcatchments and hillslopes that are organized around the drainage network, automatically extracted and defined from standard digital elevation data. A set of recursive algorithms perform the actual topographic feature extraction and synthesis into a full basin model, and also serve as the basis for processing registered information. The techniques are particularly well suited to support and parameterize distributed components runoff models as full hydrologic connectivity throughout the basin is explicitly defined. Full scale flexibility in terms of the representation of the topography and aggregation of physical units is achieved by the recursive nature of the data structure, allowing straightforward translation between scales and the investigation and choice of the appropriate scale for various hydrologic application. (Author's abstract)
W89-11286

CONCEPTUAL DESIGN FOR THE NATIONAL WATER INFORMATION SYSTEM.
For primary bibliographic entry see Field 7A.
W89-12126

10F. Preparation Of Reviews

DEGRADATION OF ATRAZINE AND RELATED S-TRIAZINES.
Kansas State Univ., Manhattan. Dept. of Chemical Engineering.
For primary bibliographic entry see Field 5B.
W89-11197

VIRUS REMOVAL BY DRINKING WATER TREATMENT PROCESSES.
Institut Armand-Frappier, Laval (Quebec). Centre de Recherche en Virologie.
For primary bibliographic entry see Field 5F.
W89-11198

ORINOCO RIVER: A REVIEW OF HYDROBIOLOGICAL RESEARCH,
Fundacion La Salle de Ciencias Naturales, San Felix (Venezuela).
For primary bibliographic entry see Field 2E.
W89-11726

HEALTH RISK ASSESSMENT OF CARBON TETRACHLORIDE (CTC) IN CALIFORNIA DRINKING WATER.
California Univ., Davis. Dept. of Environmental Toxicology.
For primary bibliographic entry see Field 5C.
W89-12096

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ABANDONED WELLS
Abandonment of Groundwater Monitoring Wells at the Savannah River Plant, Aiken, South Carolina.
W89-11929 5G

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W89-11781 2G

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W89-11223 5D

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W89-11345 5B

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W89-11451 5A

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W89-11612 5B

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W89-11822 5A

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W89-11253 2K

Light Utilization Efficiency as a Function of Stored CO2 in Leaves of Some Acidtolerant Aquatic Macrophytes.
W89-11321 2H

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W89-11341 5C

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W89-11343 5C

Early Zooplankton Response to Experimental Acidification in Little Rock Lake, Wisconsin, USA.
W89-11344 5C

Monitoring of Acidification by the Use of Aquatic Organisms.
W89-11346 7B

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W89-11527 5C

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W89-11528 5C

Changes in Na, K, Ca, Mg and Al Content of Submersed Leaf Litter, Related to Ingestion by the Amphipod Gammarus pulex (L).
W89-11545 2H

Changes in Diatom-Inferred pH and Acid Neutralizing Capacity in a Dilute, High Elevation, Sierra Nevada Lake since A.D. 1825.
W89-11552 5B

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W89-11654 5C

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W89-11344 5C

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W89-11380 2A

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W89-11654 5C

Acidification of Native Brook Trout Streams in Virginia.
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Causes and Consequences of Surface Water Acidification,
W89-11838 5B

Fish Survival in Acid Waters.
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Lower Lethal Temperatures for Carp (Cyprinus Carpio L.) and the Phytophagous Fishes (Ctenopharyngodon idella Val., Hypophthalmichthys molitrix Val., Aristichthys nobilis Rich.) in the First Period of Life (Dolne Letalne Temperatury dla Karpia (Cyprinus carpio) i Ryb Roslinozernych (Ctenopharyngodon idella Val., Hypophthalmichthys molitrix Val., Aristichthys nobilis Rich.) w Pierwszym Okresie Zycia).
W89-11494 2H

Upper Lethal Temperatures for Carp (Cyprinus carpio L.) and the Phytophagous Fishes (Ctenopharyngodon idella Val., Hypophthalmichthys molitrix Val., Aristichthys nobilis Rich.) in the First Period of Life (Gorne Letalne Temperatury dla Karpia (Cyprinus carpio L.) i Ryb Roslinozernych (Ctenopharyngodon idella Val., Hypophthalmichthys molitrix Val., Aristichthys nobilis Rich.) w Pierwszym Okresie Zycia).
W89-11495 2H

Threshold Oxygen Content in Water for Juvenile Stages of the Cyprinids (Ctenopharyngodon idella Val., Hypophthalmichthys molitrix Val., Aristichthys nobilis Rich., Cyprinus carpio L.) (Progowa Zawartosc Tlenu w Wodzie dla Mlodocianych Stadiow Ryb Karpiowatych (Ctenopharyngodon idella Val., Hypophthalmichthys molitrix Val., Aristichthys nobilis Rich., Cyprinus carpio L.)).
W89-11496 2H

Rearing of Grass Carp Larvae (Ctenopharyngodon idella Val.) in Ponds Receiving Heated Effluents: I. Scheme of the Experiment, Temperature, Water Flow in the Ponds and Fish Production (Podchow Wylegu Amura Bialego (Ctenopharyngodon idella Val.) w Stawach Zasilanych Woda Podgrzana: I. Schemat Eksperymentu, Temperatura i Przeplyw Wody w Stawach Oraz Wyniki Rybackie).
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Rearing of Grass Carp Larvae (Ctenopharyngodon idella Val.) in Ponds Receiving Heated Effluents: II. Physico-Chemical Conditions (Podchow Wylegu Amura Bialego (Ctenopharyngodon idella Val.) w Stawach Zasilanych Woda Podgrzana: II. Warunki Fizyczno-Chemiczne).
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Rearing of Grass Carp Larvae (Ctenopharyngodon idella Val.) in Ponds Receiving Heated Effluents: III. Food Conditions (Podchow Wylegu Amura Bialego (Ctenopharyngodon idella Val.) w Stawach Zasilanych Woda Podgrzana: III. Warunki Pokarmowe).
W89-11499 3C

Rearing of Grass Carp Larvae (Ctenopharyngodon idella Val.) in Ponds Receiving Heated Effluents: IV. Food (Podchow Wylegu Amura Bialego (Ctenopharyngodon idella Val.) w Stawach Zasilanych Woda Podgrzana: IV. Pokarm).
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1 NATURE OF WATER

2 WATER CYCLE

3 WATER SUPPLY AUGMENTATION AND CONSERVATION

4 WATER QUANTITY MANAGEMENT AND CONTROL

5 WATER QUALITY MANAGEMENT AND PROTECTION

6 WATER RESOURCES PLANNING

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1989 Price Schedules for the United States, Canada, and Mexico

These prices are for customers in the United States, Canada, and Mexico; other customers, write for price list PR-360-4.

Microfiche & Paper Copy Reports				Computer Products			
Standard Prices		*Exception Prices*		*Diskettes*		*Magnetic Tapes*	
A01	$6.95	E01	$9.00	D01	$50	T01	$150
A02	10.95	E02	11.50	D02	75	T02	210
A03	13.95	E03	13.00	D03	125	T03	325
A04-A05	15.95	E04	15.50	D04	175	T04	425
A06-A09	21.95	E05	17.50	D05	225	T05	525
A10-A13	28.95	E06	20.50	D06	275	T06	625
A14-A17	36.95	E07	23.00	D07	325	T07	725
A18-A21	42.95	E08	25.50	D08	375	T08	825
A22-A25	49.95	E09	28.00	D09	425	T09	925
A99	*	E10	31.00	D10	475	T10	1,025
		E11	33.50	D11	525	T11	1,125
		E12	36.50	D12	575	T12	1,225
		E13	39.00	D13	625	T13	1,325
		E14	42.50	D14	675	T14	1,425
		E15	46.00	D15	725	T15	1,525
Published Searches & Special Directories		E16	50.50	D16	775	T16	1,625
		E17	54.50	D17	825	T17	1,725
		E18	59.00	D18	875	T18	1,825
		E19	65.50	D19	925	T19	1,925
N01	$55.00	E20	76.00	D99	*	T99	*
N02	55.00	E99	*				

* Contact NTIS for price

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